

**Reconnaissance Geology and Geochemistry
of the
SOUTH MOUNTAIN - JUNIPER MOUNTAIN REGION
Owyhee County, Idaho**

by
Earl H. Bennett



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BUREAU OF MINES AND GEOLOGY

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Pamphlet No. **166**

COVER PICTURE

NASA aircraft, color infrared image
showing Juniper Mt. flow lobes (bottom)
and Upper basalt vent and flows (center
and top).

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Moscow, Idaho

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INTRODUCTION

This reconnaissance geologic study of the South Mountain-Juniper Mountain region, Owyhee County, Idaho, was undertaken to provide basic data that can be readily applied to future land-use planning and mineral evaluation projects. This study was a cooperative effort between the Idaho Bureau of Mines and Geology and the U. S. Bureau of Land Management and had four major objectives.

- (1) to provide a reconnaissance geologic map for the South Mountain-Juniper Mountain region.
- (2) to conduct a geochemical survey of the area.
- (3) to provide a structural (linear) map from remote sensing imagery.
- (4) to combine the above surveys into an overall interpretation of the mineral potential for the region.

ACKNOWLEDGMENTS

A number of people contributed to the completion of this project. Financial support was provided by the Office of Scientific Systems Development, Bureau of Land Management, Denver, Colorado. I specifically wish to thank its director, Ralph Morrill.

Edward Barnes (Bureau of Land Management, Boise, Idaho) enthusiastically provided the use of his personal aircraft for much of the low-altitude photographic work.

Dr. William Hall (University of Idaho) provided U-2 imagery and helped with the photogeologic interpretation. Kenneth Meehan (photo-geology) and James Williams (computer programming/geochemistry) helped with much of the data processing and analysis. Leanne Barnes conducted all of the chemical analyses and Carol Johnson edited the final report. Dr. Peter Siems, Dr. John Bond and Dr. Robert Jones edited the technical aspects within the report.

W. A. Bowes and Company provided mine and surface maps for its holdings at South Mountain and A. R. Hanson (Anschutz Corporation) provided some deep well data. The ranchers throughout the area were most cooperative and gave the field party free access to their properties.

I would like to thank Betsy Douglas for keeping track of the numerous samples and maps for the project and give special thanks to my field assistants, William Strowd and Warren Barrash.

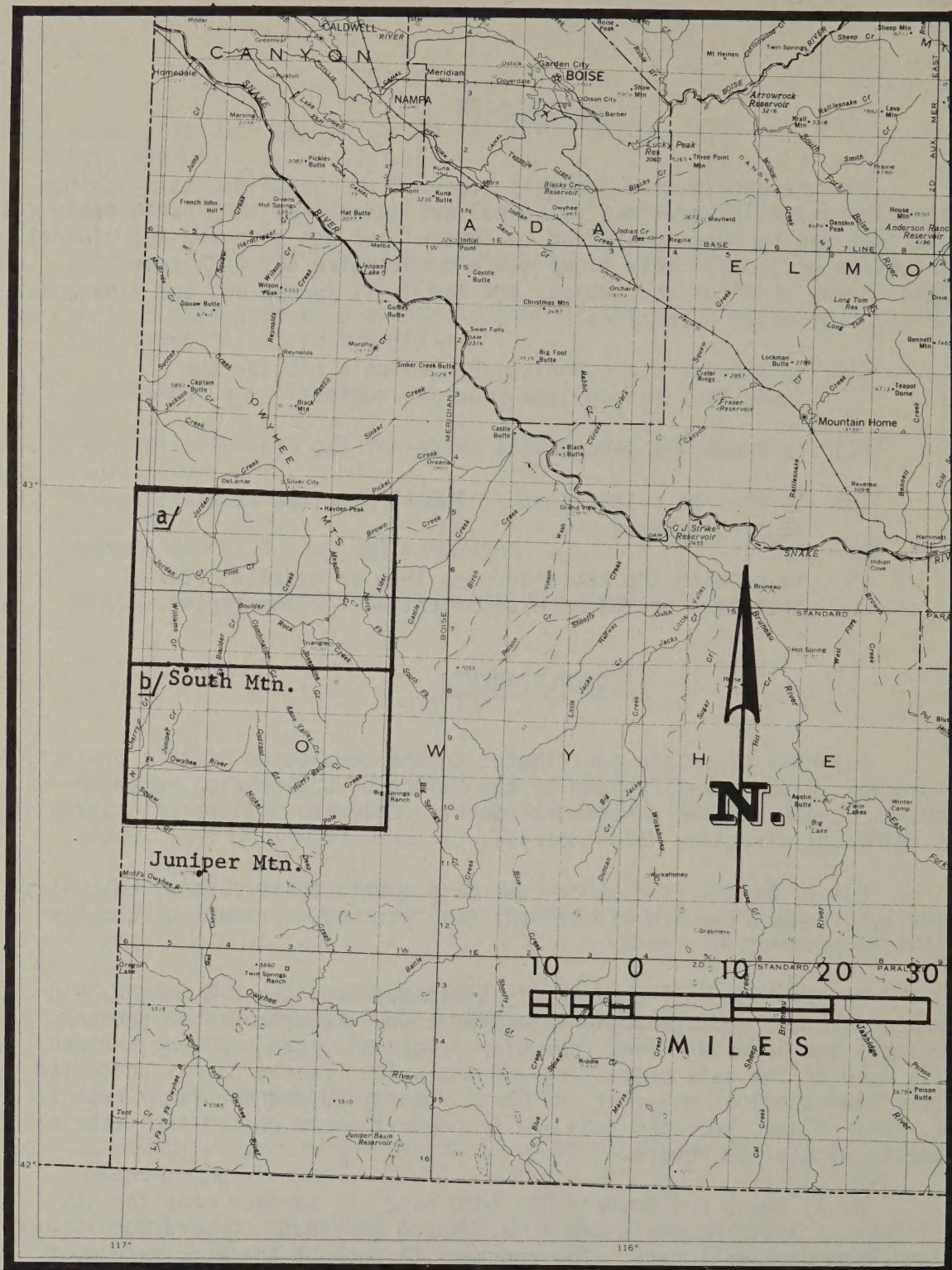


Figure 1. Index map section a/ mapped by Bennett and Galbraith, 1975
 section b/ mapped by Bennett (this report)

GEOGRAPHIC SETTING

The South Mountain-Juniper Mountain study area encompasses approximately 450 square miles in the southwest portion of Owyhee County, Idaho (Figure 1). For mapping purposes, eight advance copies of 7½ minute topographic quadrangle maps for the Juniper mapping project of the U.S. Geological Survey (the Juniper 3 series - NW, NE, SE, SW; eastern half and the Juniper 4 series - NW, NE, SE, SW; western half) were combined, reduced to two 15 minute quadrangle maps and used as the base map for this report (Plate 1). The boundaries of the area extend from 116° 30' 00" to 117° 00' 00" west longitude and 42° 30' 00" to 42° 45' 00" north latitude. As the Juniper 3 and 4 series are preliminary topographic maps, all stream names and other geographic data were transcribed to the composited base maps from Bureau of Land Management's Juniper Creek planimetric map.

There are no towns within the study area. A few ranchers maintain semi-permanent year round residences, but these are without electricity. The U.S. Bureau of Land Management maintains a fire lookout on South Mountain and a small camp at Mud Flat in the summer months.

The area is reached by travelling approximately 20 miles south on dirt roads from Jordan Valley, Oregon, or 40 miles west from Grand View, Idaho. Access from either town leads to the Deep Creek road, a dirt road traversing the area in an east-west direction. This road crosses the North Fork of the Owyhee River and continues north along the western boundary of the area.

The Deep Creek road is maintained by the U.S. Bureau of Land Management, but is often impassable in wet weather except to four wheel drive vehicles. Subsidiary roads crossing basalt units tend to turn very slick after a rain and should be avoided.

Figure 2 is an orthogonal topographic projection of the eastern half of the Jordan Valley AMS (1/250,000 scale) map of Owyhee County. The projection extends from Silver City to the Nevada border in a north-south line. Various place names and geographic features in the study area are noted on this figure. Figure 3 is a topographic projection of the immediate study area between South Mountain and Juniper Mountain.

The study area is part of the Owyhee Plateau which is a relatively flat plateau extending in a northwest-southeast direction and paralleling the Snake River Plain. South Mountain and the peaks surrounding Silver City reach or exceed 8,000 feet. An east-southeast trending ridge (elevation about 6,000 feet) between South Mountain and Antelope Ridge acts as a drainage divide between the Juniper 3 and 4 quadrangles and the Triangle-Flint Creek quadrangles to the north (Plate 1). This ridge also forms the southern edge of a bowl shaped depression which includes much of the Triangle-Flint Creek quadrangles.

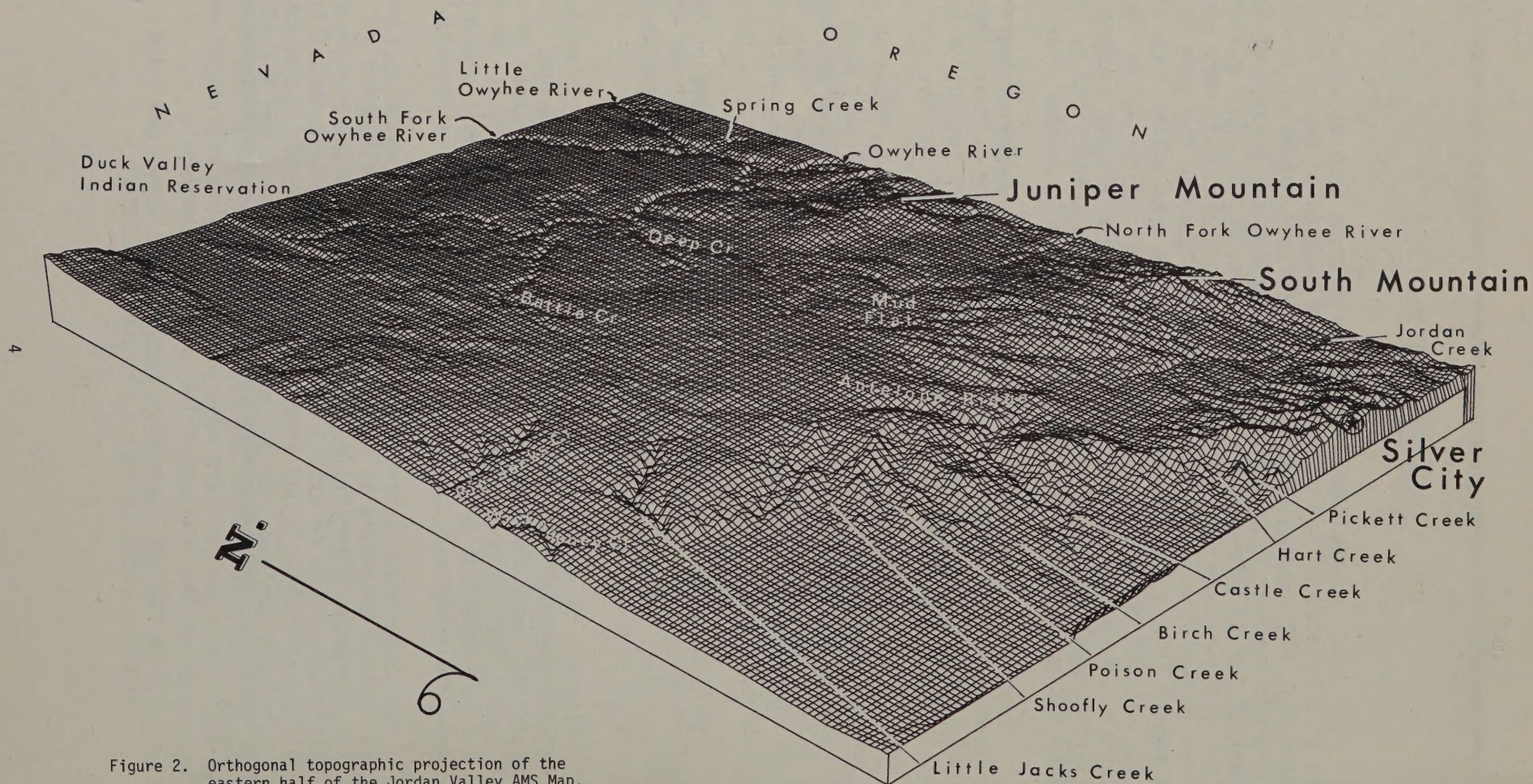


Figure 2. Orthogonal topographic projection of the eastern half of the Jordan Valley AMS Map. scale: 1:250,000.

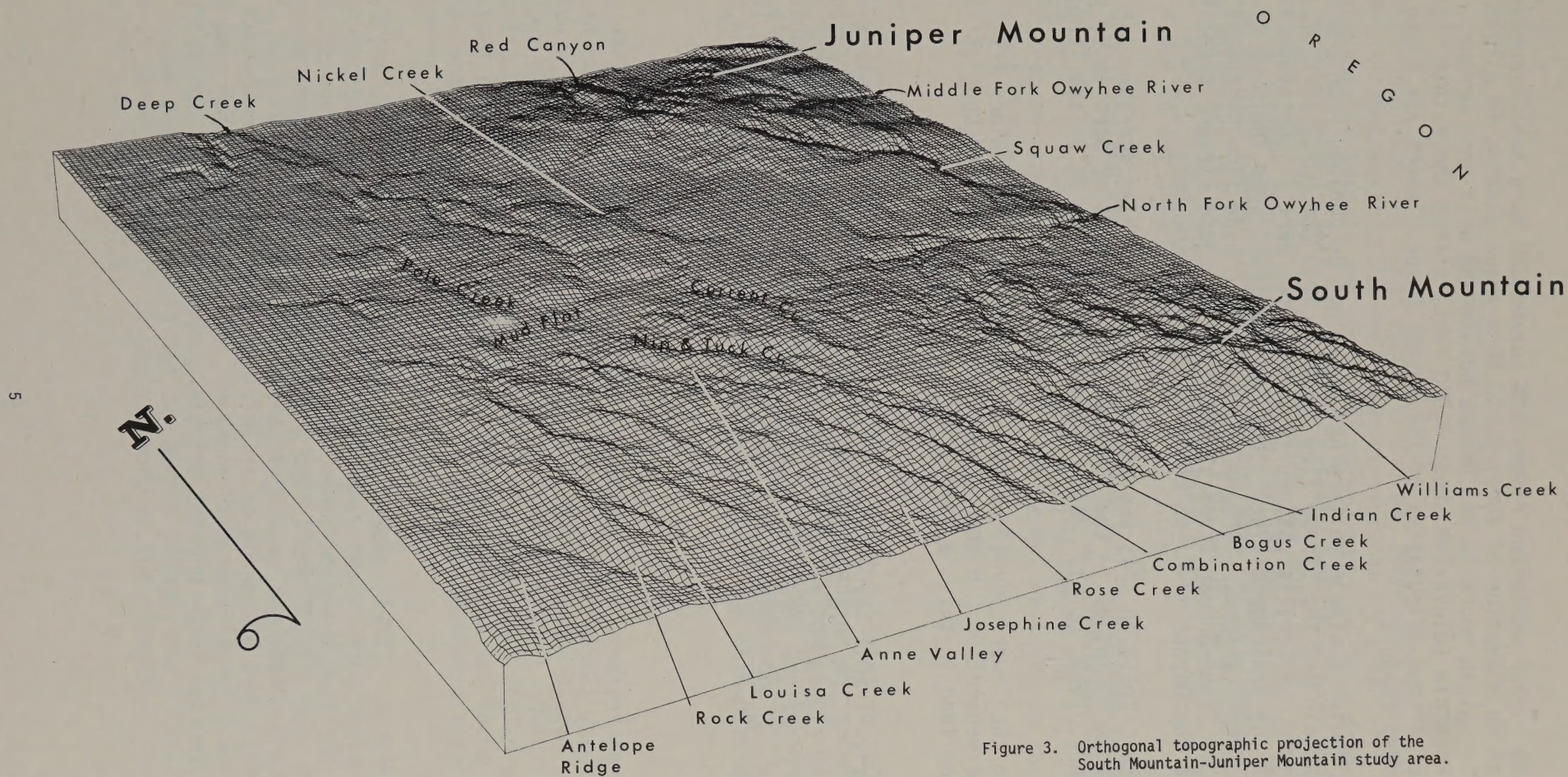


Figure 3. Orthogonal topographic projection of the South Mountain-Juniper Mountain study area.

The higher peaks and ridges are surrounded by a basalt-covered plateau at an elevation of about 5,500 feet which extends in a relatively flat plain south to the Nevada border and west into Oregon. Juniper Mountain (elevation about 6,000 feet) stands above this flat plain and various tributaries of the Owyhee River dissect the plain, carving deep canyons.

A radial drainage pattern has developed on Juniper Mountain and South Mountain and the stream flow trend is into the North Fork of the Owyhee River. A trellis pattern in the central part of the study area (south of the drainage divide) flows southeastward into the Deep Creek and Pole Creek systems. Streams north of the divide flow northwest into the Boulder Creek-Jordan Creek system. All of these streams eventually flow into the Owyhee River which flows north to the Snake River.

The climate in this region is semi-arid with an average rainfall of less than 10 inches in the lowlands and 20 inches or more above 6,000 feet (Asher, 1968, p. 6). Most of the precipitation is in the form of snow.

In the lower elevations grasses, sagebrush and juniper trees dominate the vegetation. Higher slopes have some alpine and Douglas fir. Use of the land in this region is for stock grazing.

Most of this country is fairly rugged; the ridge and valley topography forming the north-central part of the map area can be confusing as all the ridges and valleys appear to be similar, on the ground. Appropriate precautions should be taken if one traverses "cross country" in this area. A good compass and map are essential. Another hazard is rattlesnakes, which were frequently observed throughout the region.

GEOLOGIC SETTING

Geologically, the South Mountain-Juniper Mountain area consists of a granitic/metamorphic basement overlain by a Tertiary volcanic sequence of basalts and rhyolitic pyroclastic and lava flows which are in turn covered in part by various Tertiary and Quaternary sediments and basalts. The Tertiary volcanic sequence has been broken into three units: (1) "Lower" Basalt sequence which is time equivalent to the Columbia River Basalts commonly seen in north and west central Idaho, (2) the Idavada Volcanics (silicic tuffs and flows) of Malde and Powers (1962), and (3) "Upper" Basalt sequence (Banbury Basalt) which is equivalent to basalt flows in the Snake River Plain.

Armstrong and others (1975) have shown the chronologic relation of these volcanic units. Some of their K/Ar dates are combined with new dates by Neill (1975) as shown in Figure 4. The age of the silicic flows and tuffs become progressively younger from Oregon eastward to the Yellowstone-Island Park caldera centers.^{1/}

PREVIOUS INVESTIGATIONS

The Geologic Map of Idaho by Ross and Forrester (1947) is the only available map covering the geology of the immediate study area. Figure 5 is an index map showing the status of the geologic mapping to date in the surrounding areas. A good review of the general geology is given by Neill (1975). Previous to this report, no known geochemical work has been undertaken for this region.

1/ Two different viewpoints are given to explain the progressive age change in the silicic units. Christiansen and Lipman (1972) suggest that the Snake River Plain and related volcanism is a fracture system related to western plate tectonics as discussed by Atwater (1970). Overriding of the Pacific Plate by the America's Plate could explain a rift zone like the Snake River Plain. As the rift progressed eastward the focus of volcanism at the front of the rift would also progress eastward resulting in the observed age sequence in the volcanics.

Quite a different view is presented by Morgan (1972). A mantle plume which is located under Yellowstone Park at the present time could have created the age sequence as the continent moved westward over the plume. Mathews and Anderson (1973, p. 158) show that theoretically many of the tectonic features of the western United States can be explained by the "Plume Mechanism". Their ideas are similar to Burke and Dewey (1973, p. 406) who postulate that triple junctions form above these plumes and these junctions are in part responsible for forming major tectonic features. Suppe and others (1975) use two mantle plumes, one in Yellowstone and one in Raton, New Mexico to explain many of the geomorphic and seismic features in the western U.S.

FIELD WORK AND MAPPING PROCEDURES

Field work was conducted from June through August of 1975. During this period the geology of the area was mapped and 583 stream sediment samples were collected for analysis.

The geologic mapping was done on 1:30,000 scale, black and white air-photos and on 1:130,000 scale, color, infrared U-2 imagery. The map lines were later transferred to topographic maps. Approximately 4,000 linear miles of traverse were made by field personnel and most traverses were covered at least twice, once for sediment sampling and once for mapping. The mapping is considered reconnaissance in nature as its purpose was to broadly define lithologic units for consideration in the geochemical analysis.

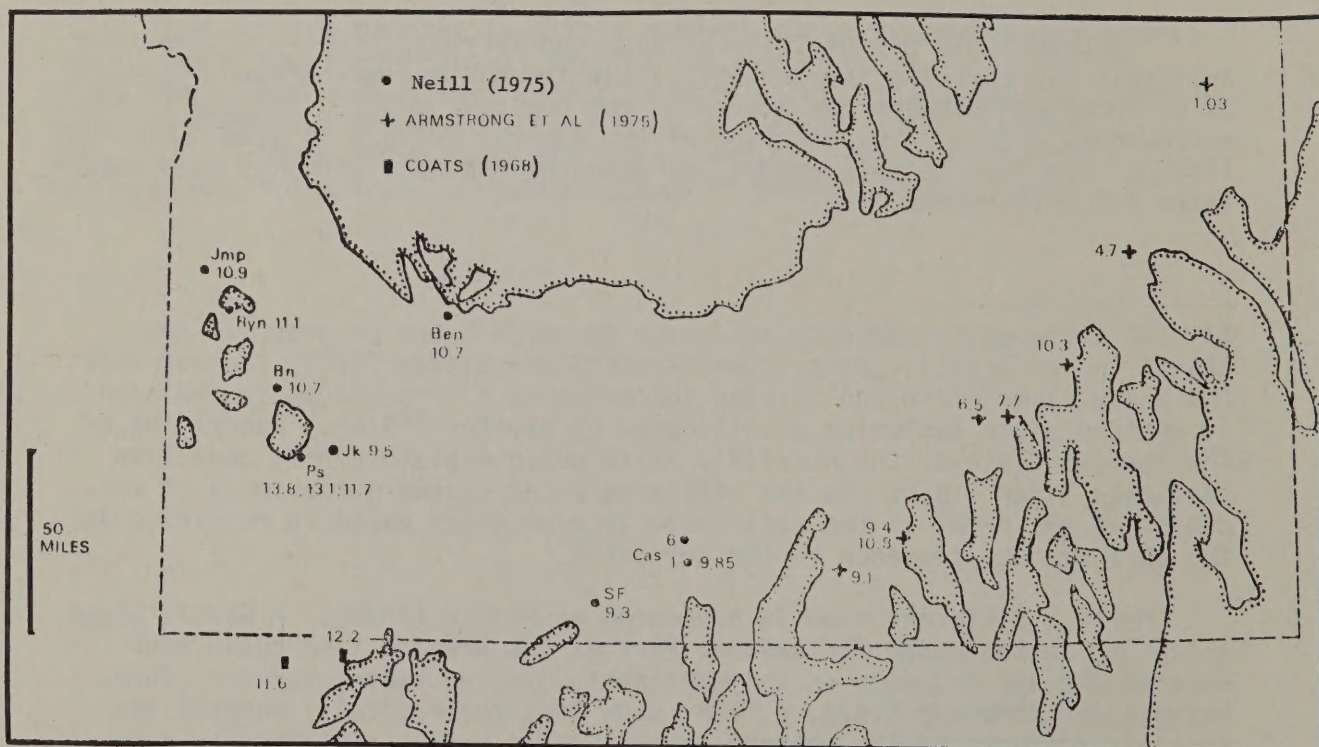


Figure 4. K-Ar dates of silicic volcanic rocks of the Snake River Plain. (from Neill, 1975)

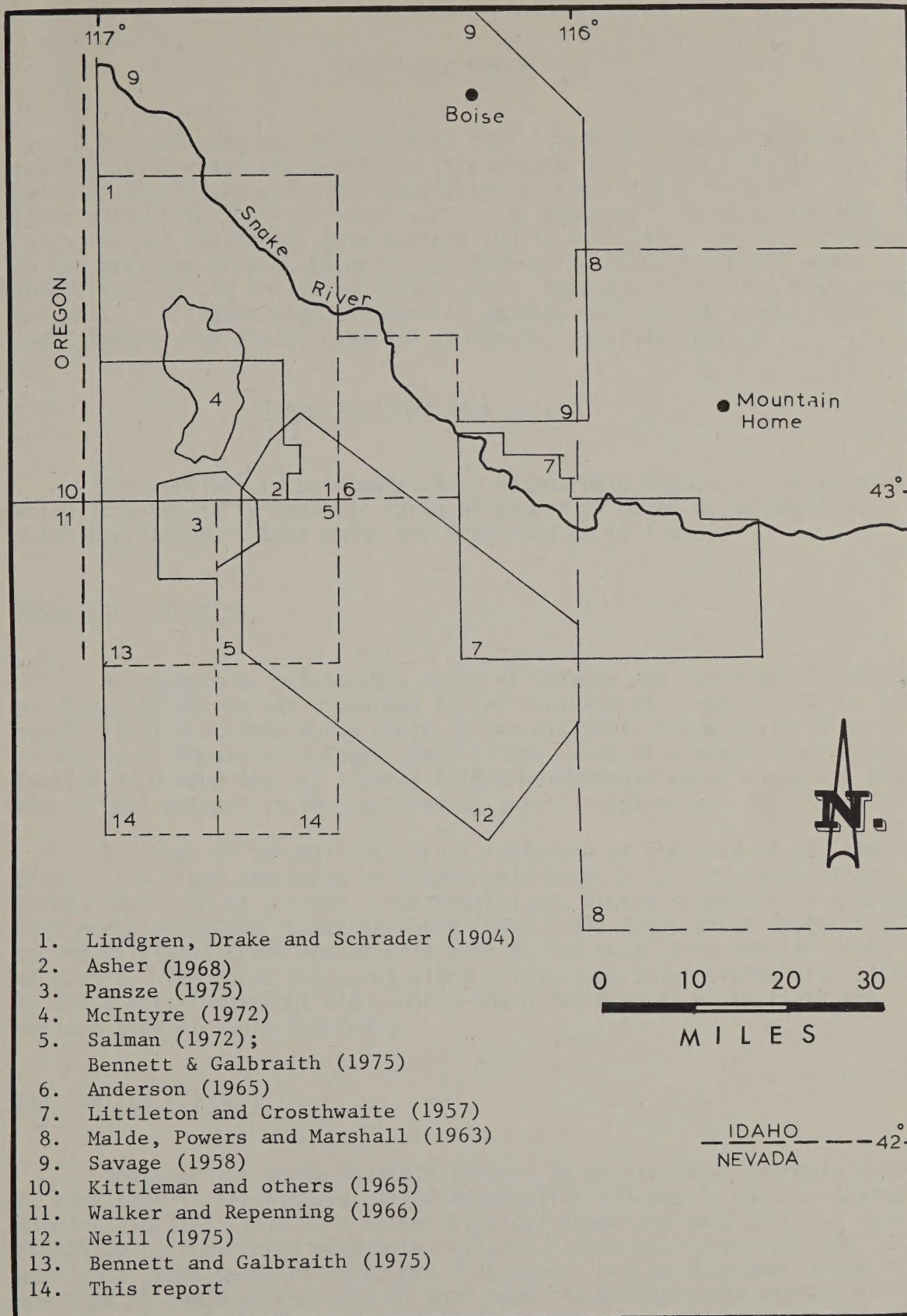


Figure 5. Index map showing existing geologic maps in and around the study area.

LITHOLOGIC UNITS

The geologic map of the study area (Plate 1) shows eleven field mapable units which are described from oldest to youngest. Table 1, based on literature and field observations, shows the correlation of these units with those of other workers in the area. As dates for all units are not available, this correlation is tentative. Several changes in our previous mapping (Bennett and Galbraith, 1975) are noted where appropriate in the following discussions. Appendix A contains eight black and white U-2 images with the general geology outlined on them. These eight images give stereo coverage of the entire study area.

PRE-TERTIARY ROCK UNITS

Pre-Tertiary rocks consist of a metamorphic sequence (age unknown) which is intruded by granitic rocks which are believed to be Idaho batholith equivalent. These units are described as follows:

Metamorphic Complex

A sequence of metamorphic rocks of unknown age composed of schists, marbles, and quartzites crops out in the vicinity of South Mountain. Sorenson (1927) described these rocks in the William's Creek drainage north of the South Mountain lookout. In Williams Creek is a sequence of approximately 3500-4000 feet of tightly folded metamorphic rocks which are probably a roof pendent in the surrounding granitic intrusion.

Outcrops of the Williams Creek rocks end at the head of William's Creek. Two other exposures of metamorphic rocks crop out along Soldier Creek (NW corner of Juniper 3 quadrangle) and another exposure is located just north of Soldier Creek on Sheep Creek. All three areas appear similar to the William's Creek metamorphic unit except that there are few exposures of marble. The three exposures along Soldier and Sheep Creeks are caused by differential movement along north-south fault zones which flank the western side of South Mountain.

Amphibolite (?) Unit

South of the South Mountain lookout is an east-west elongate zone of rock that is tentatively called amphibolite but may in part be quartz diorite/diorite. This is a rather atypical appearing unit which is characterized by very large amphibole crystals. In a weathered specimen, amphibole cross sections up to one inch across may be observed. Some of the rock is composed entirely of what seems to be amphibole whereas in

Table 1. Tentative correlation of lithologic units in the Silver City - Juniper Mountain region
southwestern Idaho and southeastern Oregon

Bennett and Galbraith, 1975	Bennett, 1976	Neill, 1975	Asher, 1968	Walker & Repenning, 1966
Qa1- Alluvium	Qa1	Alluvium	Qa1- Alluvium	Various Quaternary units
Qap- Placered gravels	not present	not present	Qpg- Placered gravels	
Q1- Landslide deposits	not mapped	not mapped	Q1s- Landslide deposits	
Qbg- Bench gravels	not present	Pediment gravel	Qbg- Bench gravels	
Tbb- Banbury basalt equiv.	Tbb	Banbury basalt	Tbb- Banbury basalt Ttb- Tuffaceous basalt	
Tcl- Idaho Group	not present	Poison Cr. Fm.	Tpc- Poison Cr. Fm.	Tsb- tuffaceous sed. rocks tuffs and interbedded basaltic and andesitic flows Tb- Basalt (ed. note-not sure of correlation to other authors units) Ttr- tuffs silicic flows tuffaceous sed. rocks
Tur- Silver City rhyolite	not present	Silver City rhyolite	Tsc- Silver City rhyolite	
Tt ₂ - Welded tuff 2 not present	not present Tjt- Juniper Mt. tuff/flow complex	Owyhee Ridge member not present	Tt ₂ - Welded tuff unit 2 not present	
Included in Tt ₁	Tat- Antelope Ridge tuff	Owyhee Plateau member	not present	
Included in Tt ₂	not present	Browns Cr. member	(possible equiv. to eastern part of Asher's Tt ₁)	
Tt ₁ - Welded tuff 1 Sucker Cr. F., outcrops just west of the study area*	Tt ₁ and Tt _{1a} not present	Poison Cr. member not mentioned	Tt ₁ - Welded tuff unit 1 Ts- Sucker Cr. Fm.	Tfb- Basalt flows & flow breccias not present not present not present
Tfb- Flow breccia	not present	not present	not present	
Tq1- Quartz latite	not present	Included with Silver City rhyolite	Tqd- Qtz latite domes	
	Tfd - Felsic domes (stratigraphic position unknown)			
Tlb- Lower basalt not present	Tlb- lower basalt not present	Basalt-Columbia River age Eocene volcanics (Challis age equiv.)	Tbl- Basalt-latite unit not present	
Ktg- Granodiorite/Qtz monzonite	Ktg- Granodiorite/ Qtz monzonite	Idaho bath. equiv. granitics	Ki- Silver City Granite	not present not present not present
not present	Amp- Amphibolite	not present	not present	
Meta- metamorphic complex	Meta- metamorphic complex	metamorphic rocks	not present	

PLEISTOCENE	QUAT.
PLIOCENE ? - ? - ?	TERTIARY
MIOCENE	
EOCENE	
CRETACEOUS	MESOZOIC
? ? ?	

*age relationship not precisely known in relation to Tfb and T_{q1}.

other areas the amphiboles are in a dioritic appearing matrix. The amphibolite unit is covered by the "lower basalt" sequence to the east, west and south.

The contact between the amphibolite and the granodiorite/quartz monzonite is gradational. In the transition zone between these units the granitic unit becomes finer grained and more granophyric in appearance. The contact between the amphibolite and the granitics although transitional, is very obvious in the field and on the U-2 imagery because the amphibolite supports more vegetation in comparison to the granitics.

Granodiorite-Quartz Monzonite Intrusive

As noted, the metamorphic rocks at South Mountain are surrounded by intrusive rocks which are granodiorite/quartz monzonite in composition. These are believed to be part of the Idaho batholith-Nevada intrusive complex. Pansze (1975, p. 26) dated granitic rocks in the Silver City area which are similar to the South Mountain rocks at 62-67 m.y. This is equivalent to younger ages given for Idaho batholith rocks to the north. Some outcrops of this intrusive unit contain xenoliths. Typically, the granitic rocks are complexly intermixed with metamorphic units.

TERTIARY VOLCANIC UNITS

The basaltic-rhyolitic assemblage of Tertiary volcanic rocks in the present study area has been subdivided into six mappable units which are believed to be in stratigraphic order as follows:

- | | |
|---|-------------------------|
| 6. Upper (Banbury?) basalt | "upper basalt" sequence |
| 5. Juniper Mountain tuff and flow complex | } Idavada Volcanics |
| 4. Antelope Ridge tuff | |
| 3. Welded tuff 1 and subfacies Tt _{1a} . . . | |
| 2. Felsic domes | |
| 1. Lower basalt | "lower basalt" sequence |

These are discussed in the following paragraphs from oldest ("lower basalt") to youngest ("upper basalt").

Lower Basalt

"Lower basalt" crops out in the South Mountain area and, in general, completely surrounds the mountain (Plate 1). The unit lies unconformably on the granitic-metamorphic basement and in turn is overlain unconformably by the welded tuff units. Pansze (1975, p. 30) dated the "lower basalt" in the Silver City area at 16.6 m.y. which makes these rocks

equivalent to Columbia River Basalt; however, compositionally these rocks are alkali basalts while the Columbia River Basalts are more tholeiitic (McIntyre, 1971, p. 13). Pansze(1975) also obtained two younger dates on these basalts (12.8 m.y. and 13.0 m.y.), but chose the older date because of field and stratigraphic relations.

The "lower basalt" at South Mountain ranges texturally from aphanitic to porphyritic. The porphyritic flows are most interesting as some contain plagioclase laths up to one inch long and others contain pyroxene phenocrysts that are the size of a nickel. These are, in hand specimen, similar to older Columbia River Basalt units north of the Snake River Plain.

The ridge east of the headwaters of Soldier Creek is capped by a porphyritic basalt with large pyroxene phenocrysts; what is believed to be this same unit is located at the bottom of the Soldier Creek drainage. This offset is the result of north-south faulting which has downdropped blocks of the basalt to the west. What seems to be a very thick sequence of basalt on the western flank of South Mountain, is a result of several such fault repetitions of strata. The entire sequence in this area is probably not more than 800 feet thick.

"Lower basalt" is extensively exposed south of the South Mountain lookout and in a narrow corridor east of South Mountain. It crops out extensively north of the lookout as well (Bennett and Galbraith, 1975, p. 10). Most of the sequence strikes due north and dips shallowly east at varying degrees. Piper and Laney (1926, p. 21) noted that the origin of the "lower basalt" at Flint (north of the present study area) was by fissure flow. The source area for "lower basalt" at South Mountain is unknown.

Felsic Domes

Three small felsic domes were mapped near the contact of "lower basalt" and welded tuff 1 subfacies Tt_{1a}. Two of these are north of Anderson Reservoir and the third is on Cabin Creek. Figure 6 shows how one of these domes appears from the air. Vitrophyre is interbedded with what appears to be altered white ash units in these domes. The domes may intrude "lower basalt", but their age relative to other units is unknown.

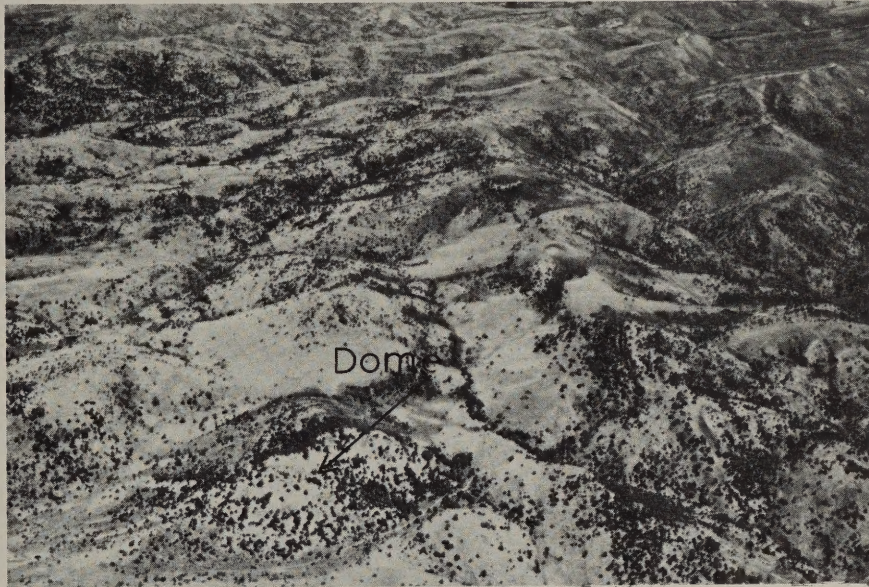


Figure 6. Felsic dome south of South Mountain.

IDAVADA VOLCANIC UNITS

Introduction

The Idavada Volcanics are an extensive sequence of silicic volcanic units composed primarily of pyroclastic flows and/or tuff lavas overlying "lower basalt". The overall sequence, as named by Malde and Powers (1962), included some basalt units, but in the present study the term is applied only to the silicic volcanic units.

Units of Idavada Volcanics cover most of the study area and complicate the geology. The large areal extent of the units, the lack of recognized source areas and the complexity of dealing with ignimbrites in general has resulted in a poor understanding of the accumulation history of these rocks. For readers unfamiliar with ignimbrites, Peterson (1970) gives a good review of pyroclastic flow deposits including nomenclature, origin, and significance and includes a fairly comprehensive bibliography.

All workers in western Owyhee County have classified most of the silicic rocks forming the Idavada as welded tuffs and several have pointed out that there are many problems in making this classification. Neill (1975, p. 24) summarizes this position by stating *"Most of the material is probably welded ash flow tuffs but in most cases vitro-clastic texture is not apparent due to the effects of severe compaction, secondary flowage and devitrification"*. The term welded tuff as used in this report suffers from the same problems. It is used because it fits the field appearance of the rocks better than any other term. Hausen (1954) suggests that many of these units may have originated as either "froth flows" or water-charged flows (tuff lavas) as opposed to being formed by pyroclastic flow. Detailed chemical and petrographic studies are needed to solve this problem.

Another problem with classifying and mapping the tuff units is the lack of exposed sharp contacts that can be followed in the field. Contacts are often better observed on U-2 imagery once the units have been broadly differentiated by field observation (see Appendix A).

The source area problem is well illustrated by Walker and Reppening's geologic map (1966), of the western half of the Jordan Valley AMS map in Oregon. They were unable to find sources for the pyroclastic units which are extensive in their map area (note: as will be suggested later, the source for much of this material is probably in Idaho). Neill (1975) described four tuff units but did not mention source areas (note: again by chance the source areas are just outside his map area). These observations are made simply to point out that the immense size of these units makes source recognition difficult unless a regional perspective is taken.

Subdivision of the Idavada sequence and descriptions of the various units and source areas presented in the following discussion are based on

extensive use of various types of remote-sensing imagery available for the area, previous work in adjacent areas, and personal geologic observation based on extensive field coverage. These unit subdivisions are not advanced as a final interpretation of the Idavada sequence, but rather as a first approximation which may be useful to future geologic work in the area. Because of the large areal extent of the various units, several descriptive digressions will be made to exposures outside the immediate study area.

There are three welded tuff/flow complexes in the study area. These are as follows (arranged approximately in stratigraphic sequence):

3. Juniper Mountain tuff and flow complex
2. Antelope Ridge tuff
1. Welded tuff 1 and subfacies Tt_{1a}

Welded tuff 1 (Tt_1) and subfacies (Tt_{1a}).

Asher (1968, p. 48) and Pansze (1975, p. 49) described units which Asher called "welded tuff 1". Bennett and Galbraith (1975, p. 13) noted that this was the most extensive unit in the Triangle-Flint Creek quadrangles. From outcrop pattern and contact relations, welded tuff 1 appears to be the oldest tuff unit in the area. North of South Mountain the unit is in contact with the "lower basalt" latite breccia unit (Bennett and Galbraith, 1975, p. 13) and near Triangle Reservoir it is overlain by younger Antelope Ridge tuff.

Asher (1968, p. 48) described a welded tuff unit which he called "welded tuff 1" in the Silver City-Rooster Comb Peak quadrangles, and indicated that he believed this same unit was present on both the western and eastern sides of this area. It seems possible that the eastern part of Asher's welded tuff 1 is equal to the Brown's Creek member described by Neill (1975, p. 41) and dated by him at 10.7 ± 0.7 m.y. This date is similar to a date obtained from a welded tuff along Reynolds Creek road by Neill and dated at 11.1 ± 0.6 m.y. I suggest that these described units are probably all the same unit which is localized on the eastern side of Asher's area; and that this is a different unit from welded tuff 1 which is on the western side of Asher's area.

The unit extends from the north into the present study area in a broad band located between South Mountain and Antelope Ridge. It extends to the southeast where it is covered by younger tuffs and "upper basalt". A possible subfacies of the unit (Tt_{1a}) lies between the North Fork of the Owyhee River and South Mountain.

The major topographic feature in welded tuff 1 is the previously mentioned drainage divide (Plate 1) which extends eastward from South Mountain to Louisa Creek, Nip and Tuck Creek, Anne Creek, Pleasant Valley Creek and Hurry Up Creek which all flow southeast. The South Fork of

Boulder Creek, Indian Creek, Bougus Creek, Rose Creek, Wickiup Creek, Josephine Creek, Louisa Creek and Rock Creek flow northwest from the divide. This may be part of a large caldera rim which will be discussed in a latter section.

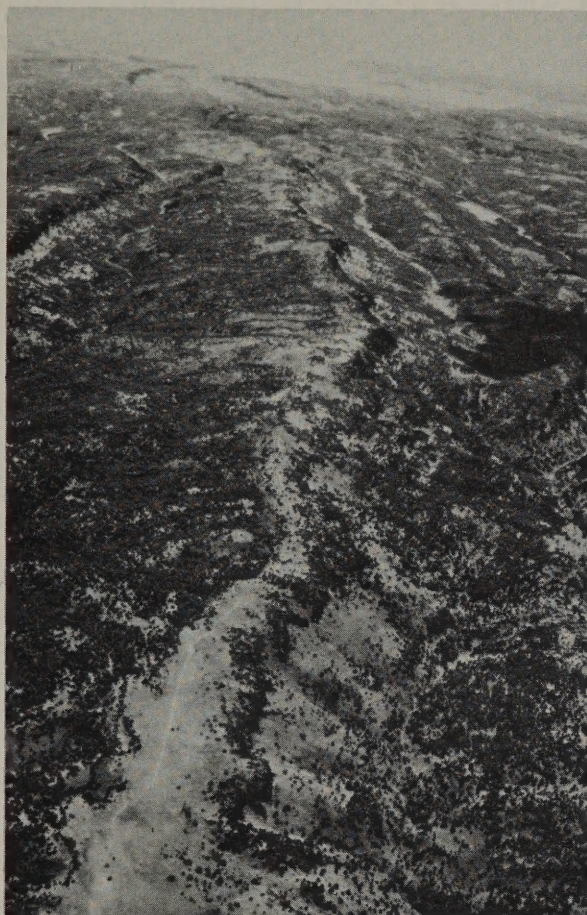


Figure 7. Typical regional appearance of Welded tuff 1.

The thickness of welded tuff 1 exceeds 600 feet in the deeper canyons along the divide (Figure 7). This welded tuff sequence is composed of several thick cooling units. Vitrophyres (highly welded zones) are uncommon in this unit. Most of the material represents the poorly welded parts of a welded tuff as described by Ross and Smith (1961); devitrification has probably resulted in the rocks induration. The tuff is reddish brown to gray on a fresh surface and weathers to a dark reddish brown. Crystals and pumice fragments are common throughout the sequence. Internally the cooling units weather out into long crude columns.

The subfacies (Tt_{1a}) of welded tuff 1 which lies between South Mountain and the North Fork of the Owyhee River looks very similar to Tt_1 with the exception that the columns are better formed and have a good horizontal jointing pattern. Tt_{1a} may possibly be a separate unit or simply represent subfacies of Tt_1 with a different cooling history.

Welded tuff 1 appears to extend far to the northeast toward Marsing, Idaho. Its southern extension is unknown as it is covered by "upper basalt". Tt_1 may be the same as Neill's (1975, p. 37) Older Poison Creek member (the Poison Creek drainage is southeast of the present study) and dated at 13.1 - 13.8 m.y., but this is not certain.

Antelope Ridge Tuff

A large tuff complex crops out from the Spencer Reservoir in the Triangle quadrangle south along Antelope Ridge to Mud Flat (Juniper 4 quadrangle) where it is covered by "upper basalt". This unit is informally

called the Antelope Ridge tuff and is the same unit as Neill's (1975) Owyhee Plateau unit. I prefer to change the name of the unit as it does not extend very far to the west and the name Owyhee Plateau implies wider coverage than the unit apparently has. Neill obtained two dates on this unit by the K/Ar method of 9.7 ± 1.5 m.y. and 9.4 ± 2.0 m.y.

Figure 8, the LANDSAT image of the area, shows the outcrop pattern of the Antelope Ridge tuff. The Spencer Reservoir-Triangle Reservoir area is mostly covered by the basal vitrophyre of this unit. Bennett and Galbraith's (1975) map should be changed to show the outcrop of Antelope Ridge tuff (Figure 8) separate from Welded tuff 1.

Neill (1975) noted that the Antelope Ridge tuff is over 1000 feet thick in Little Jacks Canyon (southeast of the present study) and gradually thins to the north. It appears to rest on Tt_1 near Spencer Reservoir.

There are three distinct parts or cooling units to the Antelope Ridge tuff: 1) a basal vitrophyre, 2) a central, horizontal, compound cooling unit with a distinctive scalloped weathering pattern and 3) an upper, more massive appearing cooling unit. The lower vitrophyre is best exposed near the Triangle and Spencer Reservoirs. It is a textbook vitrophyre with beautiful columns. The unit is a dense black glass with small crystals (probably vapor phase sanidine) scattered throughout the glass ground mass. The small area just east of South Mountain which was mapped as questionable Antelope Ridge tuff contains this distinctive basal vitrophyre and the scalloped weathering pattern of the middle unit. This indicates the Antelope Ridge tuff probably initially covered a much larger area.

The middle portion of the Antelope Ridge tuff consists of several horizontal units. These have a distinctive scalloped pattern when weathered (Figure 9). The North Fork of Castle Creek shows this pattern well. This may be caused by weathering of the individual pyroclastic flows that make up the compound unit. Neill's Figure 5 (1975, p. 38) of the Antelope Ridge tuff in Little Jack Canyon appears similar to outcrops in the Castle Creek area. The middle unit weathers into long vertical columns which part horizontally along concave joints into large cross sections which look like large dinner plates. These are known as ball and socket joints. In hand specimen the middle unit is light gray weathering to reddish-brown. Small pumice fragments are common but crystals are few. Neill (1975, p. 38) notes that large numbers of fragmented crystals are common in some units near Jack Creek.

Overlying the middle unit is a dense gray massive unit which is exposed along the Deep Creek Road eastward from Mud Flat. An excellent exposure is located across the road from the Mud Flat camp. This unit is similar in hand specimen appearance to the middle unit but lacks the columns and distinctive ball and socket jointing (it may be a part of the middle unit with a different cooling history). The southward extent of this upper unit is unknown as it is covered by "upper basalt" just south of the Mud Flat campground. Rocks very similar to this upper unit form the east wall of Split Rock Canyon approximately 35 miles to the northwest in the Flint Creek quadrangle.

EXPLANATION

10. Qal colluvium
9. Qbg Benchgravels
8. Tbb "upper basalt"
vent 8a
7. Tt₂ welded tuff 2
6. Tjt Juniper Mtn.
tuff/flow complex
5. Tat Antelope Ridge tuff
4. Tt₁ welded tuff 1
3. Challis equiv. vol.
2. Tlb "lower basalt"
1. Ktg and Meta granitics/
metamorphics

- A. Silver City
- B. South Mtn.
- C. Juniper Mtn.
- D. Nampa
- E. Reynolds Basin
- F. Jordan Valley
- G. Antelope Res.
- H. Anschutz well
(approx. loc.)

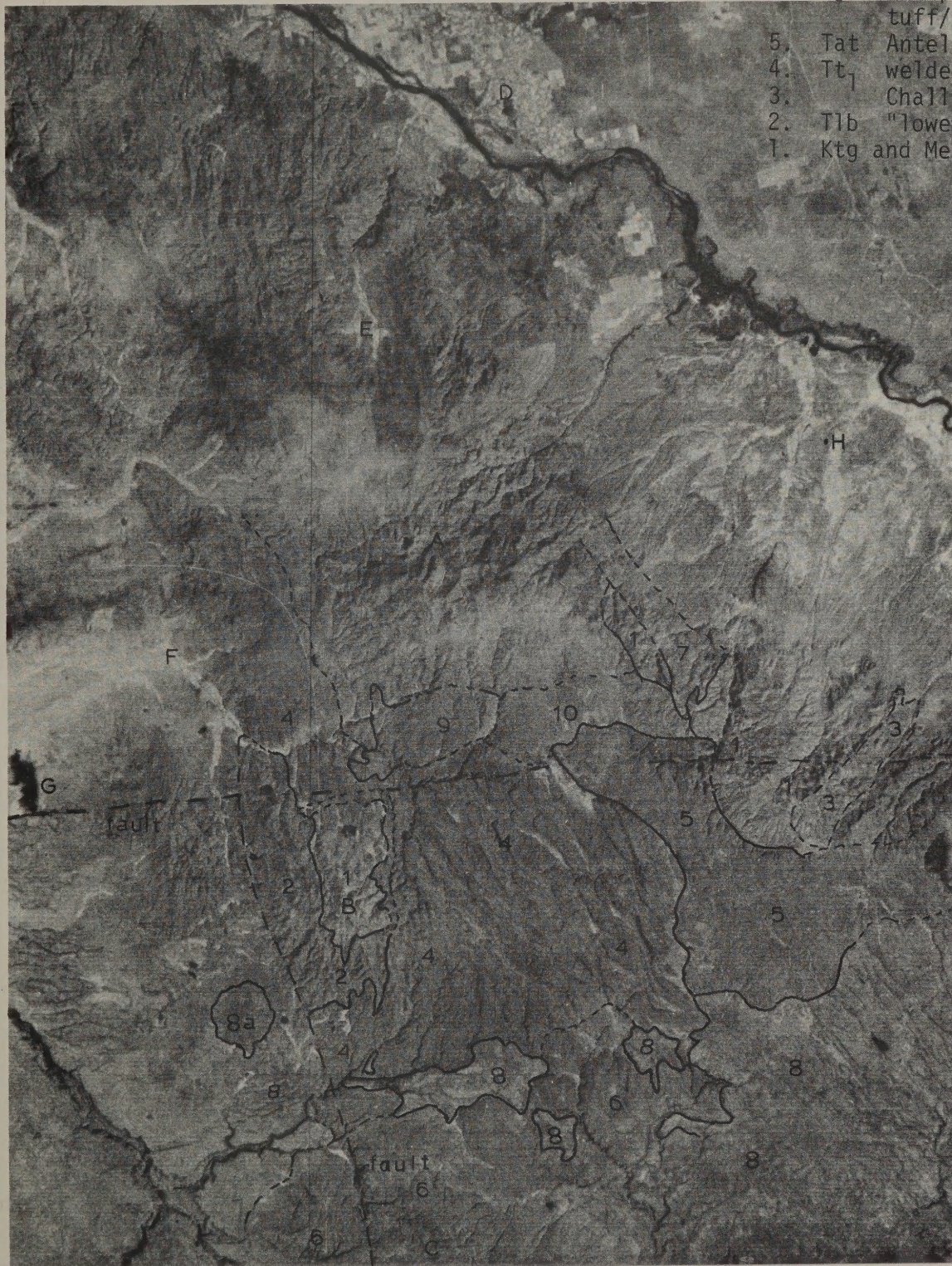


Figure 8. LANDSAT image of the study area with geology superimposed.

Examination of Figure 8 shows that the Antelope Ridge tuff extends well outside the present study area. The bulk of the unit is located in the Mahogany series quadrangles to the east. This is also believed to be the source area for this unit. The LANDSAT image (Figure 8) shows a central rosette shaped area with what appears to be flow lobes extending outward from this circular area. A curvilinear feature also appears within the central portion of this pattern which could be indicative of a collapsed central vent. A long tongue of Antelope Ridge tuff extends north along Antelope Ridge to the Triangle-Spencer Reservoir area. Another tongue crops out eastward from the vent area. Several days of reconnaissance work in the central circular area did not reveal any direct evidence of a source area but this is not unusual in silicic vents where a collapsed caldera subsequently can be filled with latter flows and tuffs and, therefore, be difficult to see. The general distribution of similar flows to the north and east, the tendency of the Antelope Ridge tuff to thicken toward this central area, the lack of crystals near Triangle and the presence of broken crystals near Jacks Creek (nearer the proposed center of the source area), all support the hypothesis that this is the source area for the Antelope Ridge tuff.



Figure 9. Weathering pattern in Antelope Ridge tuff.

Juniper Mountain Tuff and Flow Complex

An extensive series of pyroclastic and lava flows surround and cover Juniper Mountain. Only a few of the northernmost flow lobes of this sequence crop out in the present study area but these are quite obvious along the southern edge of Plate 1. The contact between these lobes

and the older welded tuff, Tt_{1a}, is hidden by the east-west trending outcrop of "upper basalt" in the Juniper 3 quadrangle. Contacts between the lobes and Tt₁ are difficult to see on the ground but can be drawn with reasonable accuracy from U-2 imagery photos. The Juniper Mountain complex appears to be younger stratigraphically than Tt₁ or Tt_{1a}, but its age relation to other pyroclastic units cannot be demonstrated and is unknown. The complex is older than the "upper basalt".

Appendix A shows the Juniper Mountain area reproduced from U-2 imagery. The flow lobes surrounding the mountain are visible. Several curvilinears which could be possible vent or ring fractures associated with caldera collapse are located near the summit of the mountain. The youngest set of flows which forms the mountain tops are also apparent. Juniper Mountain appears to be a source area for these flows and indeed is probably a major volcanic center for the Idavada Volcanics in southern Owyhee County.

The extent of coverage of the volcanic units which emanated from Juniper Mountain is difficult to assess because much of the area due south of Juniper Mountain is covered with "upper basalt" flows. The Juniper Mountain tuff/flow units are believed, however, to extend southwards at least to the main drainage of the Owyhee River as distinctive Juniper Mountain pink colored flows and tuffs form Red Canyon which drains into the Owyhee. Walker and Repenning (1966) have mapped extensive areas of ignimbrite to the west of Juniper Mountain in Oregon. As noted, they did not find any source area for these units however, the semi-circular pattern of these outcrops (map symbol Ttr, Figure 10) would center approximately on Juniper Mountain.

From a geologic point of view the pyroclastic flows and tuffs which make up the Juniper Mountain complex should afford an excellent study of the changes that occur laterally and vertically in a volcanic sequence as related to its distance from a source. Near the northern edges of the flow lobes, the Juniper Mountain tuffs are almost indistinguishable from other tuff units. As the extremities are left and the crest of Juniper Mountain is approached, the following changes occur in the tuff/flow sequence.

1. Basal vitrophyres contain large numbers of crystals up to one centimeter in length.
2. Flow banding becomes more common.
3. Crystals increase in quantity in a vertical scale in the tuff/flows and become larger as the top of the mountain is approached. It also appears as if individual flows increase in crystal content horizontally toward the source area.
4. Lithophasae are common in upper units (Figure 11).

ABBREVIATED LEGEND FOR WALKER
AND REPENNING'S MAP (FIGURE 10)

Tertiary
and
Quaternary

Pliocene (recent)

Assorted sediments and basalt flows
(see Walker and Repenning, 1966 for
details of this map).

QTSV Rocks of
Silicic vents

QTMV Rocks of
mafic vents

Tsb Tst Tob

Pliocene

Tsb - Tuffaceous sediments with interbedded basalt
and andesite flows
Tst - Semiconsolidated lacustrine sediments
Tob - Thin basalt flows

Tb

Tb - Basalt

Ttf Tts Ttr

Tertiary

Miocene?

Miocene

Ttf - Rhyolitic or dacitic tuffs.
Tts - Fine grained tuffaceous sed. rocks (lake bed
deposits)
Ttr - Partly to densely welded tuffs and flows

Ttb Tuf Tbf

Tfb - Basalt and andesite flows
Tuf - Platy andesite flows
Tbf - Massive basalt flows

5. Distinctive red and pink units which are probably lava flows instead of tuffs occur in Red Canyon and were observed only in the vicinity of Juniper Mountain.

The Juniper Mountain volcanic center is undoubtedly more complex than can be outlined by a reconnaissance report. These rocks should be dated and, as observed above, should offer an excellent opportunity for detailed petrologic and geochemical studies of both horizontal and vertical changes which occur near a silicic volcanic vent area.



Figure 11. Lithophasae in one unit of the Juniper Mountain tuff/flow complex.

Upper Basalt (Banbury Basalt Equivalent?)

The south central portion of the map area is covered by an east-west strip of "upper basalt". This unit probably is the same as the upper basalt described by Bennett and Galbraith (1975, p. 19) in the Triangle and Flint Creek quadrangles to the north. This basalt is believed equivalent to the Pliocene, Banbury basalt as described by Asher (1968, p. 46). The unit is thin, seldom exceeding 100 feet in thickness and is essentially horizontal.

The source area for the "upper basalt" in the Juniper 3 quadrangle is off the map, west of Dougal Reservoir. Appendix A shows a U-2 image of this source showing several flows which have come out of the vent. Lava flows from this vent flowed down the east-west trending valley just north of Juniper Mountain. A major north-south fault which extends from Squaw Creek to Dougal Reservoir and far to the north has down dropped the vent area relative to this valley.

The "upper basalt" in the southeastern part of the area is similar in appearance to the basalt in the western area. Basalts in both areas are open textured and tuffaceous in most hand specimens and outcrops exhibit short crude columns. The source of the eastern "upper basalt" is unknown but several low hills out on the plateau between the present study area and the Nevada/Idaho state line are possible vent locations for this material.

An extensive area of what is believed to be this same type of basalt was mapped by Walker and Repenning (1966) in southeastern Oregon. The source for this basalt may be along an extensive east-west trending fracture system which will be described in a later section.

An isolated area of "upper basalt" was mapped just east of South Mountain. The elevation of these outcrops are 6400-6500 feet which is anomalous because it is a thousand feet higher than the other flows of Tbb. This area is situated on the drainage divide in Tt₁. No source area is known for this basalt; possibly it is an uplifted erosional remnant of one of the border basalt sheets.

Interbeds and alluvium

Several interbeds are noted in Plate I. These are believed to be shallow lake deposits that formed on the welded tuffs. No fossils were observed in these units. Surficial deposits in the study area are confined to alluvium which fills major drainage valleys as noted in Plate I.

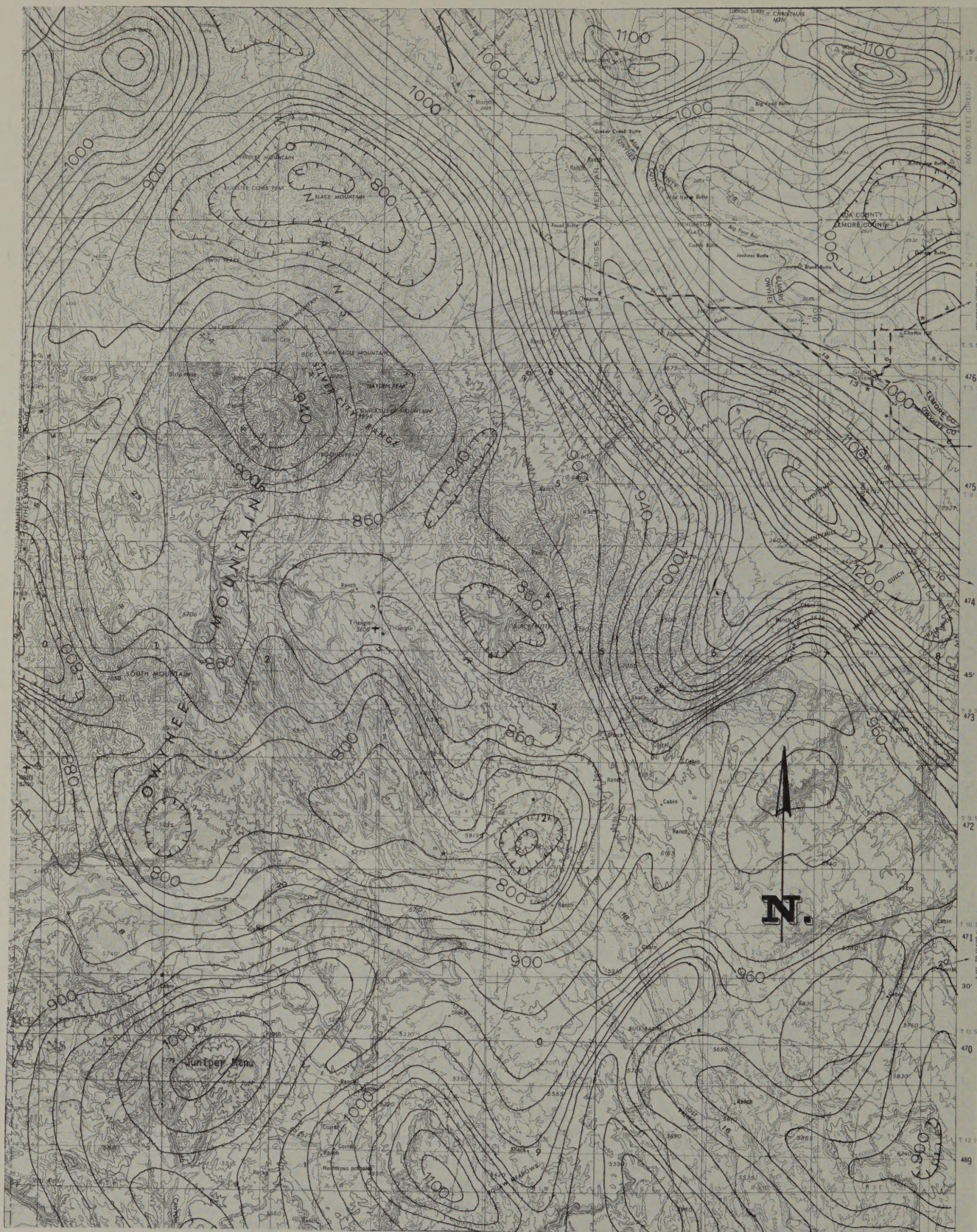
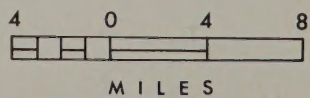


Figure 12. Air-magnetic Map of the Silver City-Juniper Mountain Region



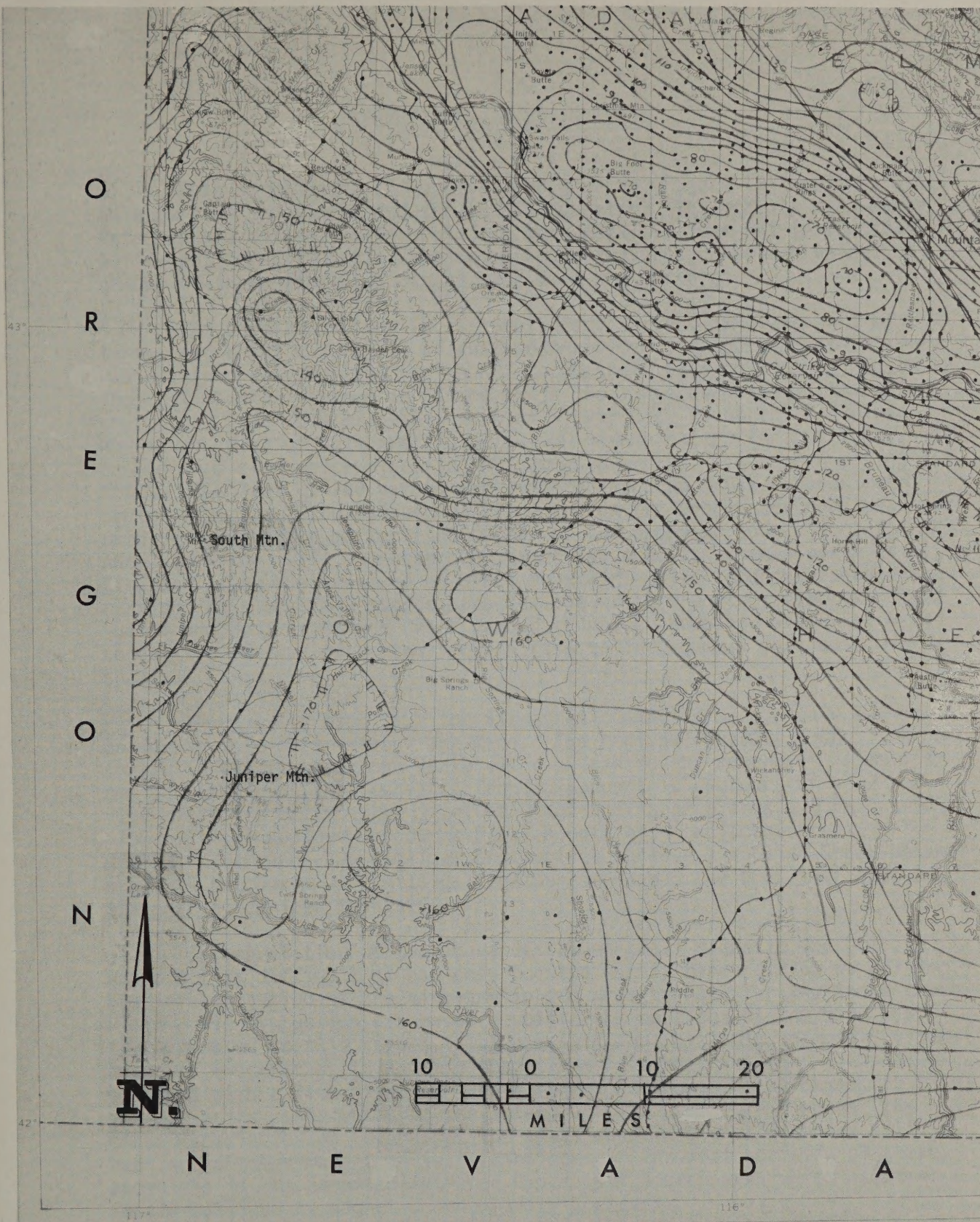


Figure 13. Bouguer Gravity Map
of the
Silver City-Juniper Mountain Region

GEOPHYSICAL INVESTIGATIONS

Both airmagnetic (Figure 12) and gravity (Figure 13) maps are available for the study area and surrounding country. The gravity map (Mabey, Peterson and Wilson, 1974) could use more data stations but is probably sufficient for delineating the broad-scale features described below. A number of interpretations can be made from the patterns.

The airmagnetic map (U. S. Geological Survey, 1971) is part of a larger map which covers all of southwestern Idaho. A portion of this map was enlarged and overlaid on the AMS topographic base to produce Figure 12. The most obvious feature in Figure 12 is the large airmagnetic low which covers the area from slightly north of Silver City to north of Juniper Mountain. Most of this area is below 900 gammas except for a slightly off center high area which rises to 940 gammas over the Flint Creek mining district. Two lows of 780 gammas are centered on Noon Creek (approximate center of the outcrop pattern of Tt_{1a}) and on the Deep Creek road near the 6020 base elevation marker (the center of the proposed source area for the Antelope Ridge tuff). Another 780 gamma low area is located north of Silver City and is nearly centered on Black Mountain. Black Mountain should be examined as a possible source area for the eastern part of Asher's Welded tuff 1 and Neill's Browns Creek member. Juniper Mountain is marked by a concentric pattern of contours which rise to 1000 gammas just east of the summit.

The gravity map, like the airmagnetic map, is broad scale and may change as more observations are made. The regional gravity trend is a decrease in gravity from the Snake River Plain to the southwest. Small anomalies interrupt this regional trend. Concentric contours of -160 and -150 milligals enclose the Antelope Ridge tuff source area. A hatchured -150 milligal contour surrounds Black Mountain and adjacent areas to the west. A -140 and -130 milligal contour set enclose the Flint Creek-Delamar area. A hatchured -170 milligal contour surrounds the area just east of the peak of Juniper Mountain.

Interpretation of the above described small magnetic and gravity anomalies is difficult as has been pointed out by Mabey (1976, p. 53) in his interpretation of the airmagnetic and gravity data for the Snake River Plain. His discussion was based on different portions of the same maps that are used in this report. The basaltic and rhyolitic "bimodal" assemblage of volcanic units and the granitic/metamorphic basement lithologies combined with a lack of subsurface information about the thickness of the various units contributes to the interpretation problem. However, the close association of several of the small anomalies with proposed silicic vent areas seems more than just coincidence. The most striking of these anomalies is the proposed Antelope Ridge tuff source area which is perfectly outlined by magnetic and gravity contours.

VOLCANIC SETTING

Examination of the data which has been gathered for the Silver City - Juniper Mountain - Southeastern Oregon areas reveals a complex pattern of volcanism which is only partially understood at the present time. The following is an overall synthesis of the volcanic history of this region which will undoubtedly be modified as work progresses in the area.

The Owyhee Plateau area has been a site of volcanic activity throughout much of Tertiary time. Between the South Fork of Castle Creek and Poison Creek is a fairly extensive sequence of volcanic and hypabyssal rocks described by Neill (1975, p. 16) and dated by Axelrod (1968) as Eocene in age (43.6 ± 0.8 m.y., biotite, K/Ar). This makes these rocks equivalent in age as well as in appearance to the Challis volcanics in central Idaho.

The next stage of volcanism is recorded by the Miocene "lower basalt" sequence (Pansze, 1971, p. 30, 16.6 m.y. + two younger dates, K/Ar) which is time equivalent (but not necessarily compositionally equivalent) to the Columbia River Basalt. Source areas for these basalts are unknown but may have been by fissure flow.

The next sequence of volcanism is recorded in the Idavada volcanics. For purposes of description the Idavada is divided into the following units with age dates and source areas as noted.

5. Welded tuff 2 - (Bennett and Galbraith, 1975; Asher, 1968) equal to the Owyhee Ridge member of Neill, 1975. Source area suggested by Bennett and Galbraith (1975, p. 16) are the silicic and latite domes of the Silver City area dated by Pansze (1975, p. 57) at 15.6 - 15.7 m.y.
4. Antelope Ridge tuff - (Bennett, this report) equals Owyhee Plateau member of Neill, 1975 and dated by him at 9.4 - 9.7 m.y. Source area in the vicinity of Battle Creek Well on the Deep Creek Road (Mahogany series quadrangles). The source area is apparent on LANDSAT imagery and marked by both air-magnetic and gravity anomalies. The original area covered by the Antelope Ridge tuff may have been extensive as rocks similar in appearance are located just east of South Mountain and in Split Rock Canyon to the northwest.
3. Browns Creek Member (Neill, 1975). This unit is a crystal rich, highly contorted welded tuff which forms much of the pediment slope between Castle and Hart Creeks. Dated by Neill at 10.7 ± 0.7 m.y.; he noted its similarity to a tuff in the Reynold's Creek area dated at 11.1 ± 0.6 m.y. This unit may be the same as the eastern portion of Asher's Welded

tuff 1. Both areas are geographically positioned for a source area in the vicinity of Black Mountain, north of Silver City, which is characterized by airmagnetic and gravity anomalies.

2. Juniper Mountain tuff/flow complex (Bennett, this report). No dates are available on this unit but it is younger than Welded tuff 1 and older than "upper basalt". The source area is near Juniper Mountain as seen on LANDSAT and U-2 imagery. Extensive areas adjacent to Juniper Mountain in Oregon may be covered with pyroclastics from this source. Airmagnetic and gravity contours enclose an area just east of the top of Juniper Mountain. Several curvilinear (possible vents) are observable on LANDSAT image near the summit of the mountain.
1. Welded tuff 1 (Bennett and Galbraith, 1975, Asher, 1968). This is believed to be the oldest pyroclastic unit in the area and is the most extensive. Neill's Poison Creek member, dated by him at 13.1 - 13.8 m.y., may equal Tt_1 as may the western part of Asher's Tt_1 . Tt_{1a} may be a sub-facies of Tt_1 or an independent unit by itself. No source area is known for this unit.

With the exception of Tt_1 , all of the Idavada units lie on or just outside the ring of exposed granitic basement which forms a large rim around a central basin which is drained by Jordan and Boulder Creek (Figure 8). The drainage divide in Welded tuff 1 forms the southern arc of this rim. This basement ridge forms a horseshoe-shaped bowl approximately 22 miles in length (north-south) and 25 miles in width (east-west). I believe evidence exists pointing to this area as a possible collapsed caldera similar in scale to the Island Park or Yellowstone calderas but 8-10 million years older. Evidence for the existence of a collapsed caldera is as follows:

1. The bowl-shaped depression is an airmagnetic low and is almost perfectly outlined by an 900 gamma contour.
2. All known silicic vents lie along or just outside the circular rim except Tt_1 which fills and flows out of the depression.
3. Smith and Bailey (1968, p. 25) note that many known collapsed calderas are traversed by grabens. Figure 8 shows that a major east-west fault transects the bowl depression and Walker and Repenning's (1966, Figure 10) map also shows this structure and many subparallel faults. This fracture system may be a source for some of the extensive "upper basalt" flows which have flooded the region.
4. The western edge of the bowl is down faulted by the same north striking fault which offset the upper basalt from its source vent near Dougal's Reservoir.

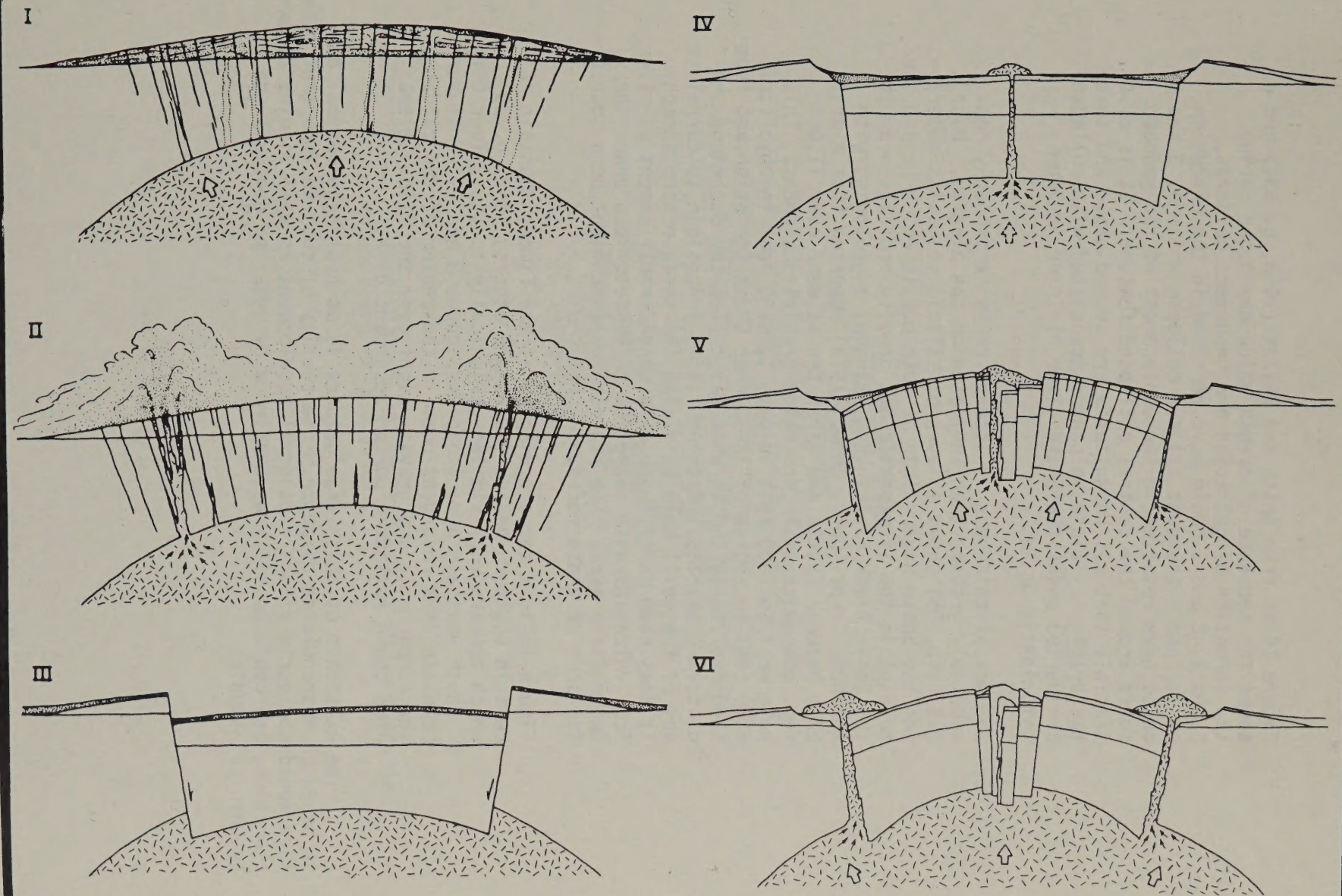


Figure 14. Sequence of events for collapsed and resurgent calderas. I Regional tumescence and generation of ring fractures. II Caldera-forming eruptions. III Caldera collapse. IV Preresurgence volcanism and sedimentation. V Resurgent doming. VI Major ring-fracture volcanism. (from Smith and Bailey, 1968)

5. Figure 14 is from Smith and Bailey (1968, p. 634) and shows the sequence of events which may occur during the formation of collapsed and resurgent calderas. Steps 1, 2 and 3 could have resulted in the extrusion of Tt₁ and subsequent caldera collapse while 4, 5 and 6 could have resulted in the emplacement of the younger tuffs around the central collapsed feature. It is also feasible that all known tuffs are second stage and that the original silicic volcanics associated with collapse are buried under the Snake River Plain or younger pyroclastic units.
6. The actual thickness of Idavada rocks is probably considerably greater than indicated on the plateau. Mabey (1976, p. 55) shows a layer of silicic volcanics underlying the Snake River Plain in both models which he proposed to explain the airmagnetic and gravity profiles over the Snake River Plain. A.R. Hanson, a geologist with Anschutz Corp. (pers. comm., 1976) reported that a drill hole between Castle and Birch Creeks went over 11,000 feet deep without intersecting granitic basement. This hole went to 2500 feet in basalt, 4700 feet in rhyolites, 5800 feet in shales of the Sucker Creek formation and from 5800 feet to bottom in what was called the Jarbridge rhyolite and basalts. Although it is impossible to correlate any of the drill hole data with the surface stratigraphy it does seem as if there is a considerable amount of silicic volcanics which have yet to be described under the Snake Plain area. The proposed caldera might be a source for some of these rocks.
7. Figure 15 is a terrain diagram of the Timber Mountain caldera in southern Nevada (Byers and others, 1968, p. 89) which appears very similar geologically to the Silver City - South Mountain area (compare Figures 3 and 19). Timber Mountain is a resurgent dome in the center of the caldera. The airmagnetic and gravity highs over the Flint-Delamar area could reflect a buried resurgent dome.

The existence of this large caldera is at best hypothetical and is based on extrapolated evidence. The reality of such an important feature would obviously affect geothermal development as well as mineral exploration, and could possibly be confirmed by detailed geologic and geophysical studies.

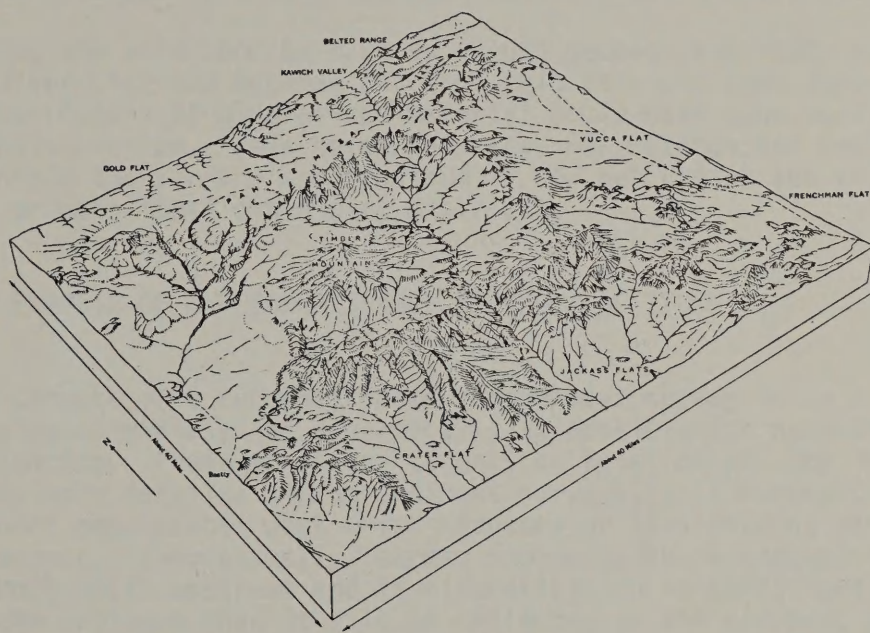


Figure 15. Terrain diagram of Timber Mountain caldera complex (from Byers et al, 1968).

RECONNAISSANCE GEOCHEMISTRY

INTRODUCTION

During the late 1800's, the total gold production from the Silver City-DeLamar region, north of the present South Mountain - Juniper Mountain study area, is estimated at approximately \$40,000,000 based on prices at the time of production (Asher, 1968). By comparison, the historical mining and exploration story of this study is insignificant. The only mining activity in the area is one adit in a small sulfide vein containing copper mineralization on Soldier Creek. Mines at South Mountain and along the South Fork of Castle Creek fall outside the project boundaries.

During the gold boom as many as 10,000 people inhabited the mining towns of Silver City and DeLamar and from this it would seem impossible that any outcropping of mineralized material would have gone unnoticed in the surrounding region. This being the case, new methods and tools to explore beneath the surface are required if new ore bodies are to be discovered in or near these old mining districts.

PURPOSE OF A RECONNAISSANCE GEOCHEMICAL STUDY

The purpose of a reconnaissance geochemical survey is to evaluate a large region as rapidly and economically as possible for potential zones of mineralization. These zones are targets or focal points for follow up work such as more detailed stream sediment surveys, soil surveys, rock surveys and/or geophysical work which industry or land holding agencies normally conduct. Theoretically, stream sediments are a composite of debris from rock units upstream and if mineralization is sufficiently presented in the drainage then it will be reflected in the sediment sample. Analysis of the sediment sample for various metallic trace elements will show areas of anomalous concentrations of these elements. Follow-up surveys can then concentrate on the drainages which contain the anomalous mineralization indicators.

The purpose of this report is to give a first approximation of the mineral potential of the study area. It is intended as a guide which will provide information to those government and private concerns which have a basic need for this type of data for sound land management and development practices.

SAMPLING PROCEDURES

A total of 583 stream sediment samples were collected from the approximately 450 square miles in the study area. Plate 2 shows the

location of each sample site and the number assigned to the sample taken from each site. One sample per square mile is generally considered adequate for reconnaissance work. Readers unfamiliar with geochemical exploration techniques are referred to Bradshaw, Clews and Walker (1972) and Levinson (1974).

The stream sediment samples were collected from the active portion of the stream. The smallest (clay-silt-sand) size particles were collected as only the -80 mesh fraction was to be analyzed. Approximately a pound of fine material was collected in labeled paper geochemical sample bags. Attempts were made to exclude as much organic material as possible from the samples; organic material may complex trace elements and produce false anomalies. Many samples collected late in the field season were taken from dry stream beds, as most of the streams in the area dry up in July. All samples were sun dried and then transported to the University of Idaho, Moscow, Idaho for analysis.

ANALYTICAL PROCEDURES

The stream sediment samples were analyzed at the Idaho Bureau of Mines and Geology analytical laboratory, University of Idaho. These were dried in electric ovens at 80°C and sieved through a -80 mesh stainless steel sieve. The -80 mesh fraction was temporarily stored prior to analysis and the coarse fraction was discarded.

Two analytical methods were used in the laboratory; atomic absorption spectrophotometry and colorimetry. The two methods analyze different aspects of the sample. Colorimetry (cold extractable techniques) uses a weak digestion which analyzes the quantity of loosely held ions such as might be absorbed on clay surfaces or in oxide coatings on sand grains. Atomic absorption uses a hot acid digestion which analyzes sulfides or oxides in the sample and some of the more easily digested silicate minerals.

Five elements were determined by atomic absorption spectrophotometry. These were zinc (Zn), nickel (Ni), lead (Pb), silver (Ag) and copper (Cu). Ten grams of sample were digested in hot aqua regia as directed in the Perkin-Elmer Manual (1973). The atomic absorption data was processed by computer to obtain final parts per million values.

Appendix B lists all of the study samples collected with the geographic x-y coordinates based on our grid system and the trace element content for each element in parts per million (ppm). Duplicate samples generally show good agreement, reflecting the reproducibility of the analytical techniques. The two cold extractable values are also given, but these are in milligram equivalents of zinc and copper instead of ppm. Appendix B was prepared by computer program REDUCE (Galbraith, 1974) written for the statistical handling of geochemical data on the University of Idaho's IBM 370 Model 147 computer.

Table 2 presents the basic statistics for the 583 samples. In Table 2 the mean is the center of gravity or central value for the element, the variance is a measure of the spread of the data, the standard deviation is the average deviation of the data from its mean, the skewness indicates the symmetry of the data about the mean and the kurtosis is a measure of the peakedness of the distribution. For many trace element distributions, histograms of the elemental concentrations are skewed and do not represent a normal distribution; however, histograms based on log transformed concentrations do approximate a normal distribution. Bennett and Galbraith (1975, p. 38) noted the log distribution of elements in the Silver City area. Histograms (not illustrated) of the present study data indicate a similar log distribution. Table 3 shows the statistics based on log transformed data for the atomic absorption analysis. The element means and threshold (mean plus two standard deviations) are converted back to ppm for reader convenience in Table 3. All values above the threshold are considered anomalous (may indicate mineralization). The raw values are, however, used in the data analysis for the cold extractable techniques as the distribution of these raw values is more normal than the log transformed data.

COMPARISON OF 1975 AND 1976 STUDY RESULTS

Table 3b shows the trace element distribution in the Silver City region from Bennett and Galbraith (1975, p. 46) based on samples from drainages of less than three square miles with contaminated samples removed (308 samples total). Bennett and Galbraith (1975, p. 47) examined several data sets based on drainage size and the presence or absence of contamination sources to try and eliminate as much of the contamination problem that exists in the Silver City area as was possible. The present study area has virtually no contamination from old mine workings so these data should be comparable with uncontaminated samples from the Silver City-South Mountain study. Comparison of the two data sets (Table 3) shows good agreement.

Several elements analyzed by Bennett and Galbraith (1975) including chromium, manganese, molybdenum and gold were not analyzed in the present study. There are several reasons for this. Molybdenum was dropped because of the unreliability of molybdenum analysis. The high correlation of chromium, nickel and manganese (all three are dependent on lithology, Bennett and Galbraith, 1975, p. 54) necessitated the running of only one of these elements. Gold analysis was also dropped because of the high correlation between gold and silver in the Silver City areas.

METHODS OF DATA PRESENTATION

Figure 16 (a-e) shows the distribution of the trace elements zinc, nickel, lead, silver and copper as symbols representing values which fall within a given small range. These maps

TABLE 2 : STATISTICS FOR TRACE ELEMENTS IN SEDIMENTS COLLECTED DURING 1975, SOUTH MT.-JUNIPER MT. PROJECT AREA, OWYHEE CO., IDAHO

OF SAMPLES = 584

VARIABLE	MEAN	STANDARD DEV.	VARIANCE	SKEWNESS	KURTOSIS
ZN	60.5603	23.9351	572.8899	1.44	7.80
NI	17.4523	16.1413	260.5403	2.15	4.69
PB	14.9775	4.4048	19.4025	0.60	0.87
AG	0.3648	0.1955	0.0382	6.48	83.74
CU	20.1612	10.4419	109.0342	1.40	1.61
THMS	2.7457	3.5484	12.5909	2.01	4.63
CXCU	0.0354	0.0740	0.0055	7.77	96.24

TABLE 3a : STATISTICS FOR TRACE ELEMENTS IN SEDIMENTS COLLECTED DURING 1975, SOUTH MT.-JUNIPER MT. PROJECT AREA, OWYHEE COUNTY, IDAHO
LOG TRANSFORMED DATA

OF SAMPLES = 584

VARIABLE	MEAN	STANDARD DEV.	VARIANCE	SKEWNESS	KURTOSIS
ZN	1.7452	0.2115	0.0447	-4.90	64.92
NI	1.1153	0.3091	0.0955	0.74	-0.02
PB	1.1560	0.1338	0.0179	-0.69	2.69
AG	-0.4807	0.1920	0.0369	-0.15	1.02
CU	1.2537	0.2087	0.0436	0.06	0.52
THMS	-0.5886	1.8073	3.2662	-1.24	-0.19
CXCU	-3.0401	1.4068	1.9791	0.78	-1.37

	MEAN	THRESHOLD
Zn	55.6216	147.3362
Ni	13.0407	54.1302
Pb	14.3217	26.5176
Ag	0.3306	0.8003
Cu	17.9345	46.8974

	MEAN	THRESHOLD
Zn	64.6	147.1
Ni	17.9	68.4
Pb	14.3	29.0
Ag	0.54	1.15
Cu	18.4	59.4

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Table 3b Area 3 mi²; contaminated samples removed (from Bennett and Galbraith, 1975).

----- PEARSON CORRELATION COEFFICIENTS -----

	ZN	NI	PB	AG	CU	CXHM	CXCU
ZN	1.0000 (585) S=0.001	0.4224 (585) S=0.001	0.1464 (585) S=0.001	0.3735 (585) S=0.001	0.5427 (585) S=0.001	0.0292 (585) S=0.241	0.1078 (585) S=0.005
NI	0.4224 (585) S=0.001	1.0000 (585) S=0.001	-0.2579 (585) S=0.001	0.2723 (585) S=0.001	0.3795 (585) S=0.001	-0.0816 (585) S=0.024	0.1380 (585) S=0.001
PB	0.1464 (585) S=0.001	-0.2579 (585) S=0.001	1.0000 (585) S=0.001	0.0761 (585) S=0.033	-0.1738 (585) S=0.001	0.2191 (585) S=0.001	-0.0204 (585) S=0.312
AG	0.3735 (585) S=0.001	0.2723 (585) S=0.001	0.0761 (585) S=0.033	1.0000 (585) S=0.001	0.3817 (585) S=0.001	0.0060 (585) S=0.442	0.0620 (585) S=0.067
CU	0.5427 (585) S=0.001	0.3795 (585) S=0.001	-0.1738 (585) S=0.001	0.3817 (585) S=0.001	1.0000 (585) S=0.001	-0.0482 (585) S=0.122	0.1734 (585) S=0.001
CXHM	0.0292 (585) S=0.241	-0.0816 (585) S=0.024	0.2191 (585) S=0.001	0.0060 (585) S=0.442	-0.0482 (585) S=0.122	1.0000 (585) S=0.001	0.1263 (585) S=0.001
CXCU	0.1078 (585) S=0.005	0.1380 (585) S=0.001	-0.0204 (585) S=0.312	0.0620 (585) S=0.067	0.1734 (585) S=0.001	0.1263 (585) S=0.001	1.0000 (585) S=0.001

(COEFFICIENT / (CASES) / SIGNIFICANCE)

Table 5. Selected trace element values for several volcanic/
plutonic rock types.

Circle Creek Rhyolite Nev. (Coats, 1968, p. 99)	Welded tuff of Idavada (Owyhee Quad) (Coats, 1968, p. 99)	Tuff of Caldera rim (Yellowstone) (Hamilton, 1965, p. 23)	Tuff erupted during and after collapse of Caldera (Yellow- stone) (Hamilton, 1965, p. 23)
Zn not detected	not detected	not reported	not reported
Ni (< .002% = < 2 ppm)	(< .002% = < 2 ppm)	(< .002% = < 2 ppm)	(< .002% = < 2 ppm)
Pb (.003% = 30 ppm)	(.003% = 30 ppm)	(.003% = 30 ppm)	(.003% = 30 ppm)
Ag not detected	not detected	not reported	not reported
Cu (.0010% = 10 ppm)	(.0012% = 12 ppm)	(.001% = 10 ppm)	(.001% = 10 ppm)
Devine Canyon tuff, Ore. Greene, 1973, p. 20	Basalts (general) Turkian and Wedepohl, 1961	Basalts (general) Vinogradov, 1962	Felsic granites and (general) granodio- rites, Vinogradov, 1962.
13 samples			
Zn not detected	105 ppm	130 ppm	60 ppm
Ni not detected to 20 ppm	130 ppm	160 ppm	8 ppm
Pb 10-50 ppm	6 ppm	8 ppm	20 ppm
Ag not detected	.11 ppm	.1 ppm	.05 ppm
Cu 5-20 ppm	87 ppm	100 ppm	20 ppm

(called Z-maps) were prepared by a computer program called ZEMAPR which was written by Howarth (1971). It was written specifically to plot geochemical data for regional reconnaissance with stream sediments. Occasionally a sample may be missing from these maps because the maps are put out on a line printer and samples that are too close together to be printed are averaged.

The data presented in the Z-maps are the log data that have been standardized. The standardized values were obtained by subtracting the mean of the data from each log value and dividing the results by the standard deviation. The advantage of using standardized data is that the values 0, 1, and 2 represent the mean, the mean plus one standard deviation and the mean plus two standard deviations (threshold value) for each element regardless of the original ppm values which may vary considerably from element to element. This procedure makes it much easier to compare the different element maps.

A few of the sample stations shown in Plate 2 and the Z-maps were moved upstream from their actual positions in order to obtain a better areally representative sample distribution. This in no way affects the data interpretation as the sample is considered a composite of all material in the drainage. The actual elemental concentration for any sample can be found easily by comparing the Z-maps with Plate 2, finding the sample number on Plate 2, and looking up the sample number in Appendix A.

The linear correlation coefficients between the five elements and the two cold extractable methods is shown in Table 4. The correlation coefficients range from 0 to 1; the closer to 1 the better the correlation between the two elements.

Table 5 is a listing of trace element qualities in various rock types which are similar to rock units in the study area. The analyses in Table 5 will be used as a qualitative estimate of background values. As the sediment samples often represent a drainage contained in only a single rock type, we can compare the sediment element concentration with the expected value (background) from Table 5 to see if anomalies are representative of possible mineralization or just different background readings in different rock types. Table 5 can only be used as a rough approximation as the chemistry of the rocks in the study area may vary considerably from the analyses in the table. Variances in weathering and elemental behavior in the secondary environment will also drastically affect rock and sediment chemical comparisons.

DISTRIBUTION OF TRACE ELEMENTS

Zinc (Zn)

Table 5 shows that zinc was not detected in any of the volcanic tuff analyses. Basalts might be expected to contain 105-130 ppm zinc and granodiorites 60 ppm. Figure 16a is the Z-map showing the distribution of zinc

in the study area. The mean value for zinc is 56 ppm and the threshold is 147 ppm. Three samples exceeded this value, 2117 (258 ppm), 1136 (147 ppm) and 3183 (164 ppm). All three of these samples are from streams which drain "lower basalt". Samples 1136 and 3183 quite possibly reflect background as zinc content in basalts is normally within this range. The location of sample 2117 might be a target area for a more detailed survey.

The rest of the data in Figure 16a shows that the next three value ranges below the threshold (\$ sign), which are represented by the symbols M, V, and O are mainly confined to the "lower basalt" (M and V) and in welded tuff 1 (best shown by the O symbol). There is an obvious decrease in the zinc content of samples from drainages in the Antelope Ridge tuff and Juniper Mountain tuff/flow sequence and a surprising lack of high zinc values in the areas covered by "upper basalt" (compare Plate 1 and Figure 16a).

Table 4 shows that zinc is best correlated with copper and next with nickel, both of which have a higher background in basalts than in felsic rocks. As noted, the correlation between zinc and CxHM (cold extractable total heavy metals) is very low.

Nickel (Ni)

The mean for nickel in this study is 13 ppm and the threshold is 54 ppm (Table 3). Nickel has a distribution in rocks similar to zinc as this element has a higher background in basalts (130-160 ppm) than in granodiorite (8 ppm) or tuffs (2-20 ppm) as shown in Table 5.

Figure 16b shows the heavy concentration of high nickel values in "lower basalt". Higher values are also common in the "upper basalt" while all of the tuff units have relatively low nickel values. Nickel has a bimodal distribution that indicates the presence of two distinct populations of nickel values in the data (one due to the basalts and one to the silicic rocks). Three samples 1136 (91 ppm), 3128 (94 ppm) and 2140 (120 ppm) contain the most nickel in the area. 1136 was also high in zinc. Table 4 shows that nickel is best correlated with copper (coefficient .88) and to a lesser extent with zinc.

Lead (Pb)

The mean and threshold values for lead in the study area are 14 ppm and 27 ppm respectively (Table 3). These values are compared to lead in tuff (10-50 ppm), basalt (6-8 ppm) and granodiorite (20 ppm).

Figure 16c shows the distribution of lead values. Anomalous samples include 2117 (33 ppm, also high in zinc), 2190 (35 ppm), 2223 (28 ppm), 2232 (27 ppm), 2262 (28 ppm) and 3183 (28 ppm also high in zinc). Table 4 shows that lead has a poor correlation with all other elements.

Silver (Ag)

The mean value for silver in the project area is 0.33 ppm and the threshold is 0.80 ppm. Silver is below detection limits in the analysis of tuff samples; it averages 0.1 ppm in basalts and .05 ppm in granodiorites. Discrepancies between the mean in this report and those from other analyses may reflect different analytical procedures and the differences in precision between these methods when analyzing for such small quantities or differences in silver mobility in different chemical environments.

Figure 16d shows the distribution of silver values. Anomalous samples include 1143 (1.0 ppm), 2190 (2.0 ppm, also high in lead), 3236 (3.2 ppm) and 3238 (.99 ppm). There appears to be a concentration of next lower values (M, V, O) in the "lower basalts" and the area surrounding South Mountain. Silver has a weak correlation with zinc and copper (Table 4).

Copper (Cu)

The values of copper in Table 5 are 5 to 20 ppm in the tuffs, 87-100 ppm in basalts and 20 ppm in granodiorites; these are compared to 18 ppm for the mean and 47 ppm for the threshold value in the project samples.

Figure 16e shows the distribution of copper values in the study area. Again there is a noticeable concentration of high values around South Mountain. There are 13 samples with over 50 ppm copper. The higher of these are 2164 (60 ppm), 2140 (57 ppm) and 2128 (57 ppm). All three are also high in nickel. There are only 3 of the thirteen anomalous samples which are not associated with anomalous nickel (3120, 3172, 2146).

The lower values of copper (especially the 0 symbol) outline on the Z-map the "upper basalt" and the north-central part of the map which is covered by welded tuff 1. As noted previously, copper correlates very well with nickel, fairly well with zinc, slightly weaker with silver and poorly with the other elements.

Cold Extractable Total Heavy Metals (CxHM)

The numbers reported for CxHM are the number of drops of dithizone added to each sample to obtain a standard value (zinc standards are used). The test is most sensitive to zinc (hence zinc equivalent values) but is also sensitive to other metallic elements (see Levinson, 1974, p. 551 for technique). The values shown in Appendix A are converted to ppm values by doubling the appendix value (i.e. reported value of $10 \times 2 = 20$ ppm).

Bradshaw and others, 1974, gives a synopsis of the advantages and disadvantages of various extraction techniques. The cold extractable techniques are very useful because they are sensitive to only the most easily removed metals. These are generally metallic ions which have been transported in ground water until pH and Eh conditions necessitate precipitation of the metals. The metals are precipitated on clays, organic matter or as hydrous oxides or metallic salts. Metals moved and precipitated by these mechanisms give rise to hydromorphic anomalies. It is these anomalies that are detected by the cold extractable methods.

Z-maps are not included for the cold extractable methods as there is only a very limited range of values reported (see Appendix B). Figure 17 shows the samples with values equal to or greater than 10 (=20 ppm zinc equivalent). There is obviously a considerable difference in the distributions of high CxHM values and anomalous samples from the more rigorous extraction used in the atomic absorption analysis (see Summary section for discussion). High CxHM values are concentrated in the eastern map area and along the South Fork of Boulder Creek just east of South Mountain. There are few high values south of the South Mountain lookout in the copper-nickel high area.

Cold Extractable Copper (CxCu)

Analysis for cold extractable copper was by the biquinoline technique (Levinson, 1974, p. 553). Values were determined by visual comparison with copper standards.

Only 5 samples (2110 = 0.20, 3107 = 0.20, 3141 = 1.0, 3144 = 1.9, 3169 = 0.20) are shown in Figure 17. All other samples were equal to or below 0.10 (10 ppm) CxCu. These values, like the CxHM analyses, are micrograms equivalent copper (multiply all C x Cu values in Appendix A by 10 to obtain ppm). Sample 3107 and 3109 also have high CxHM values. Samples 3144 and 3141 are near the head of Noon Creek and 2110 is near the confluence of Cabin Creek and Corral Creek.

SUMMARY OF GEOCHEMICAL RESULTS

Out of 583 stream sediment samples no values were found which were exceedingly high for any element. This indicates that there is little chance of finding outcrops which contain anomalous metal concentration. Figure 17 shows the location of all samples which were anomalous in any element plus the high cold extractable results.

While high values of zinc and copper (Figures 16a and 16e) from the atomic absorption analysis are concentrated south of South Mountain, next higher values are concentrated in the north-central map area covered by

Welded tuff 1. Bennett and Galbraith (1975, p. 52) noted that Welded tuff 1 was high in silver just north of the present study boundary. It is possible that these next lower values indicate mineralization beneath the ridge which forms the drainage divide in Welded tuff 1.

An interesting difference in distribution is shown by the cold extractable techniques and atomic absorption analysis (Figure 17). Many of the higher cold extractable values lie in the eastern map area in the Antelope Ridge tuff and the Sunshine Valley/Camel Creek area. These may be hydromorphic anomalies reflecting deeper mineralization especially in the Antelope Ridge tuff as there are mines along the South Fork of Castle Creek just east of the present study area. The CxCu and CxHM anomalous area along and just east of the South Fork of Boulder Creek is most interesting as this is also the area of anomalous "upper basalt".

Anomalous values from the atomic absorption analysis are located mainly in the South Mountain area and probably reflect the chemical difference between the "lower basalt" and the other more felsic units.

Several areas which might be of interest to future workers include:

1. The Sunshine Valley/Camel Creek area which has anomalous silver and cold extractable values (sample 3236, 3.2 ppm Ag).
2. The location of sample 2117 (anomalous Pb and Zn) between Juniper Creek and Cabin Creek just east of Anderson Reservoir.
3. The area just east of the South Fork of Boulder Creek (high CxCu and CxHM values).
4. The drainage divide in Welded tuff 1.

Soil sampling as well as stream sediment sampling should be employed in follow up work in these areas.

Figure 16 (a-e) Z maps showing the distribution of the standardized log values for trace elements.

KEY TO MAP SYMBOLS

less than -4.000	blank
from -4.000 to -2.001	
from -2.000 to -1.501	,,,,,,,,,,
from -1.5000to -1.001	-----
from -1.000 to -0.501	+++++++
from -0.500 to -0.001	=====
from 0.0 to 0.499	//////////
from 0.500 to 0.999	0000000000
from 1.000 to 1.499	VVVVVVVVVV
from 1.500 to 1.999	MMMMMMMMMM
greater than 2.000	\$\$\$\$\$\$\$\$\$\$



Figure 16a Zinc (Zn)

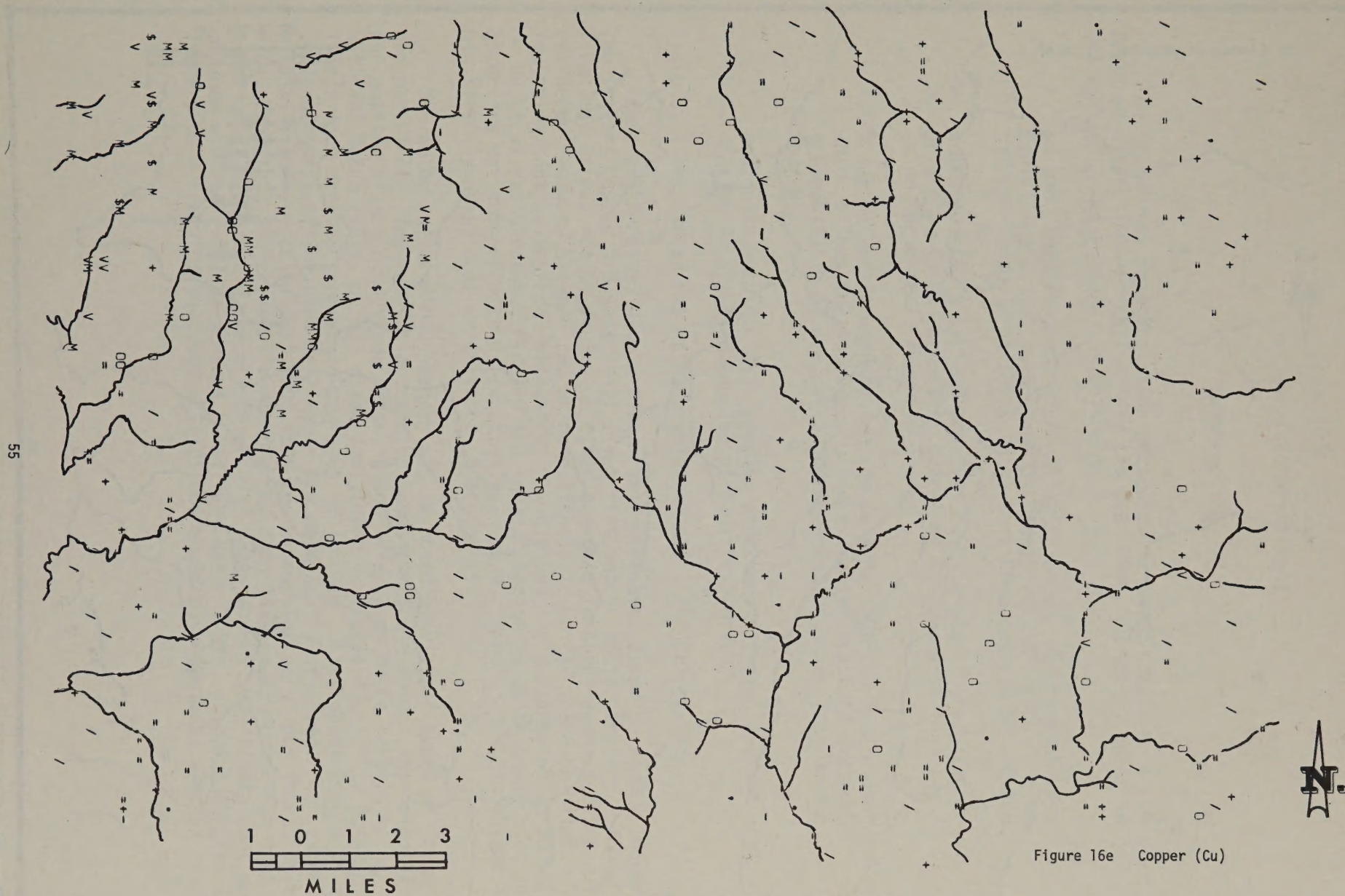


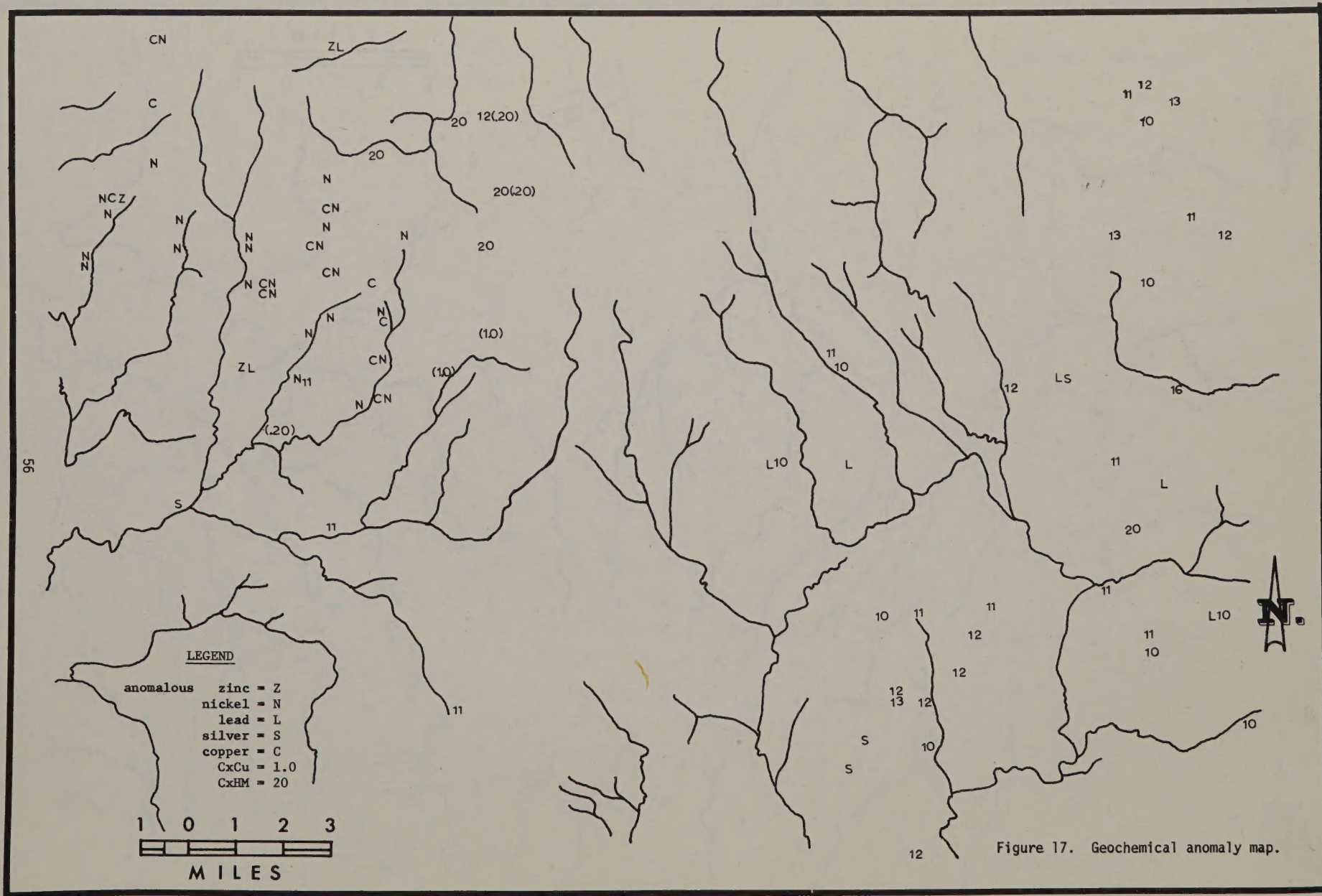
Figure 16c Lead (Pb)





Figure 16d Silver (Ag)





STRUCTURAL GEOLOGY
(Linear Interpretation)

INTRODUCTION

The structural interpretation presented is based solely on a computer assisted linear interpretation from the U-2 1:130,000 scale, color infra-red imagery. The reasons for this are:

1. In the field evidence of faulting is rarely observed as most faults are eroded scarps and all positive signs such as gouge, slickensides, drag folds, etc. have been removed by erosion.
2. Extensive fault systems are difficult to see in the field from ground level as continuity over long distances is lost (as it is on large scale imagery).
3. A far better interpretation can be made from the remote imagery which allows the observer to see extensive fracture systems, especially in an area with poor vegetative cover like Owyhee County.
4. Reconnaissance geologic mapping precludes spending a great deal of time in detailed mapping of fault systems.

Plate 3 is the linear map which overlays Plate 1 for orientation.

There are problems with a linear interpretation based on remote imagery. The linears mapped are just that; lines that appear on the imagery. These lines may or may not be faults or other geologic features such as differentially weathered contacts between two or more lithologic units, veins or dikes. Some faults may not be observed because of low dipping fault planes which do not show on vertical photography. Finally the interpretation is quite subjective and two observers may come up with different linear maps. Many of these problems are minimized by using only experienced interpreters.

The color infrared U-2 imagery was selected over other types of imagery because of its fine resolution, and because each frame covers approximately one quarter of the study area allowing long fractures to be easily traced. Hall and Walsh (1974, p. 17) noted that there is little similarity between linear maps derived from various scales of imagery. As a general rule as the scale becomes smaller, longer linears are more easily observed. For example, LANDSAT imagery (scale 1:250,000) is good for mapping very long fractures and a map from this imagery will contain a few long linears in comparison to a map based on 1:30,000 scale imagery which will contain many more linears but most of them will be relatively short. Hall and Walsh (1974, p. 33) suggested that imagery on a scale of 1:70,000 - 1:125,000 would give the best overall results.

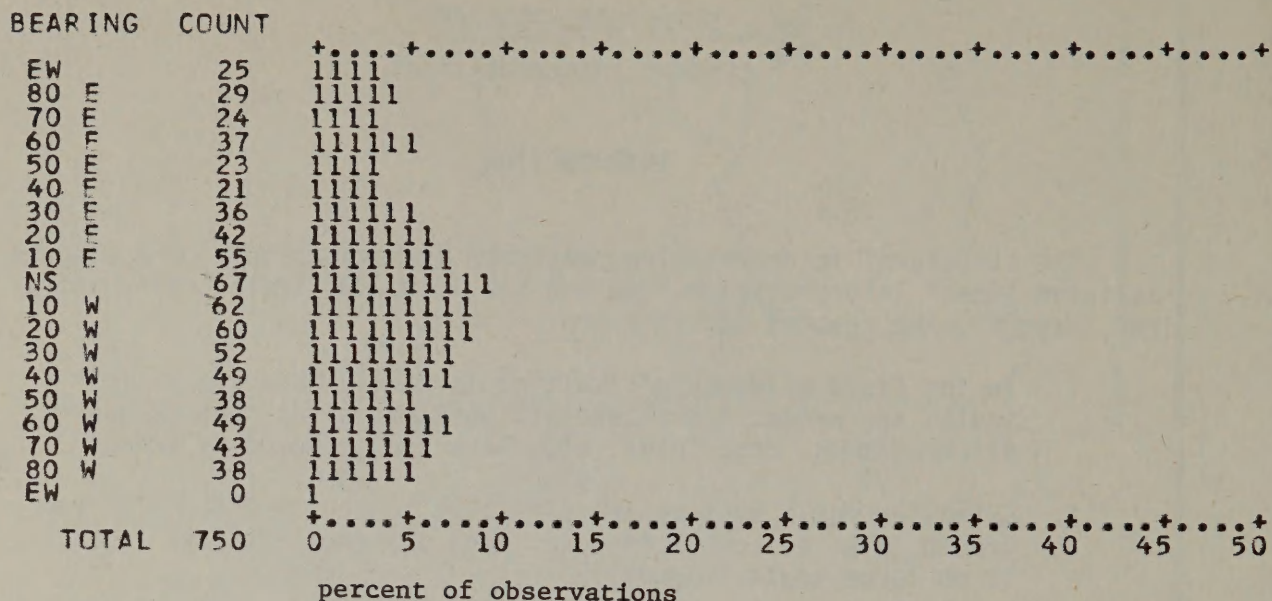


Figure 18a Distribution of linears by azimuth and length.
Linear lengths are between 0.0 and 12.0 inches.

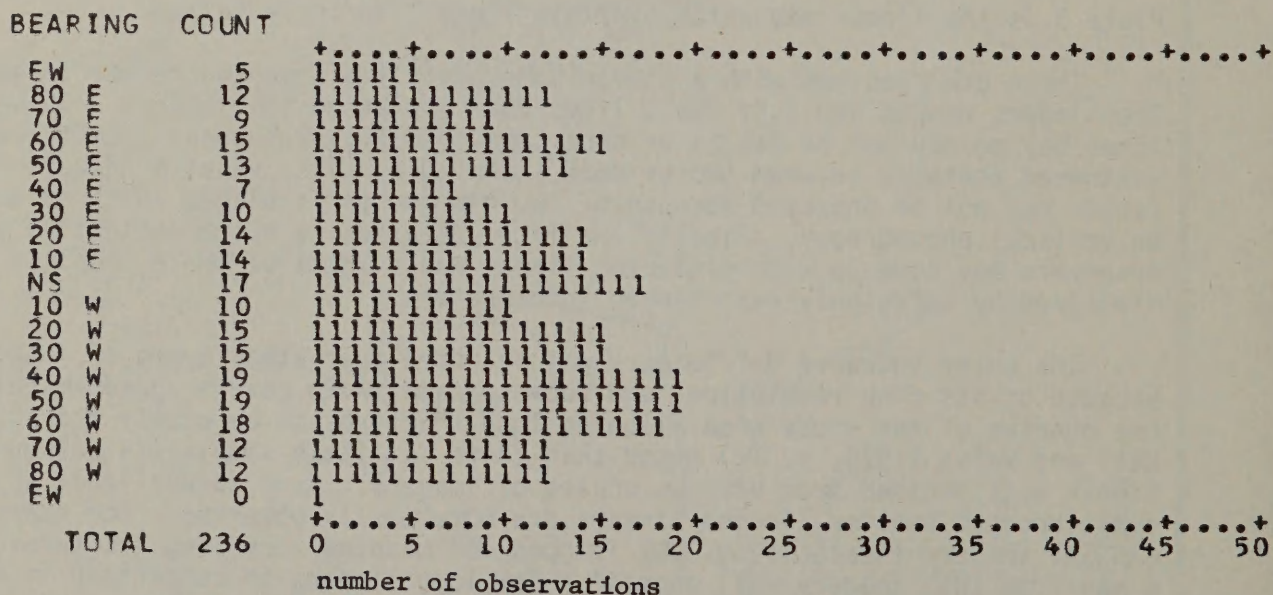


Figure 18b Distribution of linears by azimuth and length.
Linear lengths are between 0.0 and 1.0 inches.

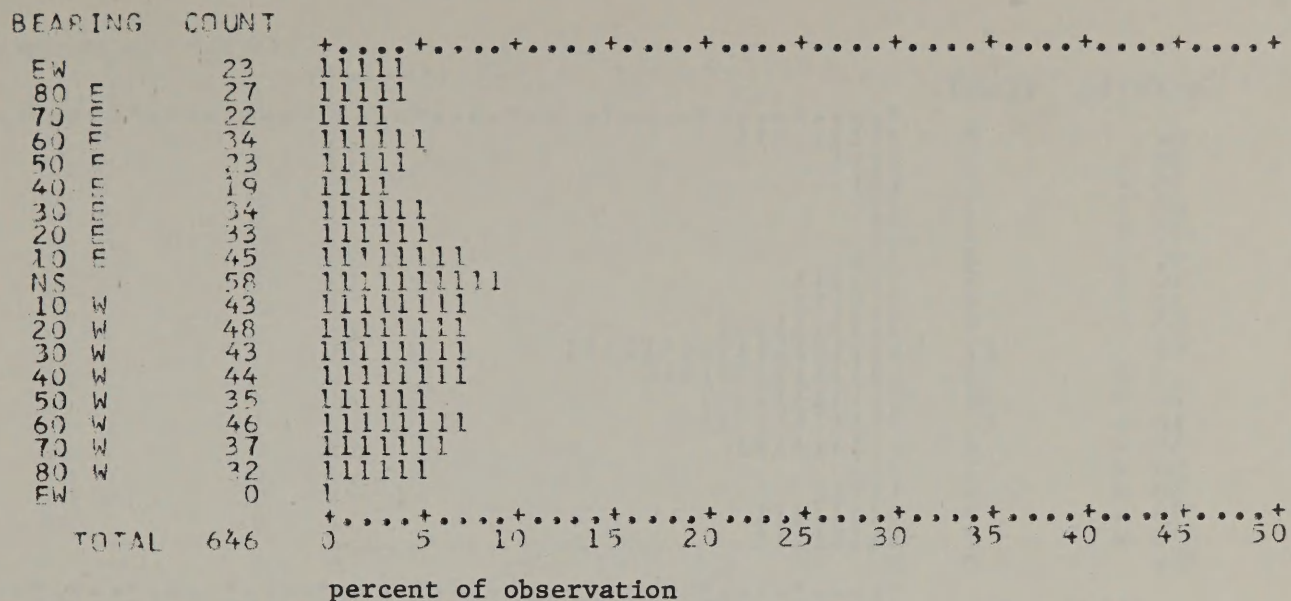


Figure 18c Distribution of linears by azimuth and length.
Linear lengths are between 0.0 and 3.0 inches.

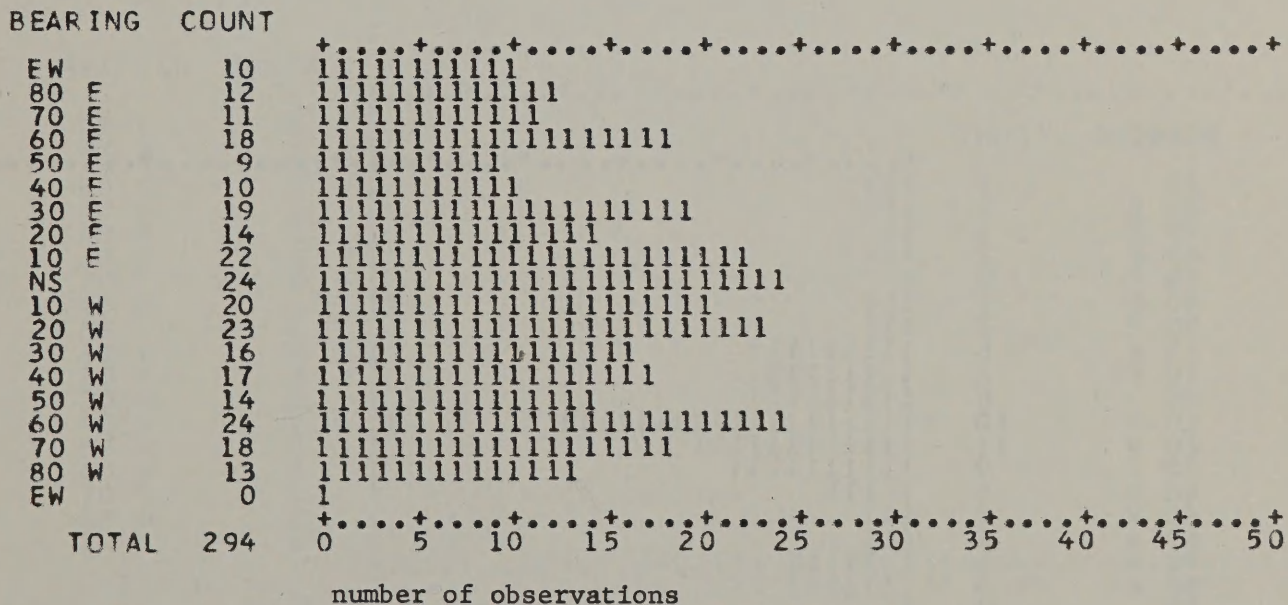


Figure 18d Distribution of linears by azimuth and length.
Linear lengths are between 1.0 and 2.0 inches.

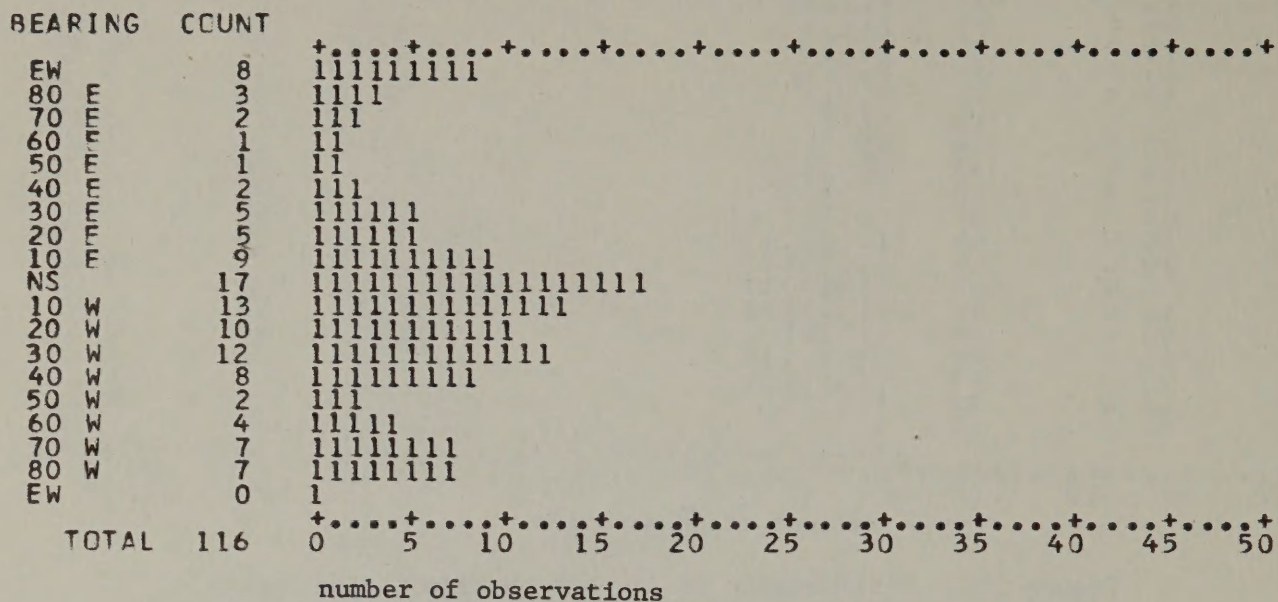


Figure 18e. Distribution of linears by azimuth and length. Linear lengths are between 2.0 and 3.0 inches.

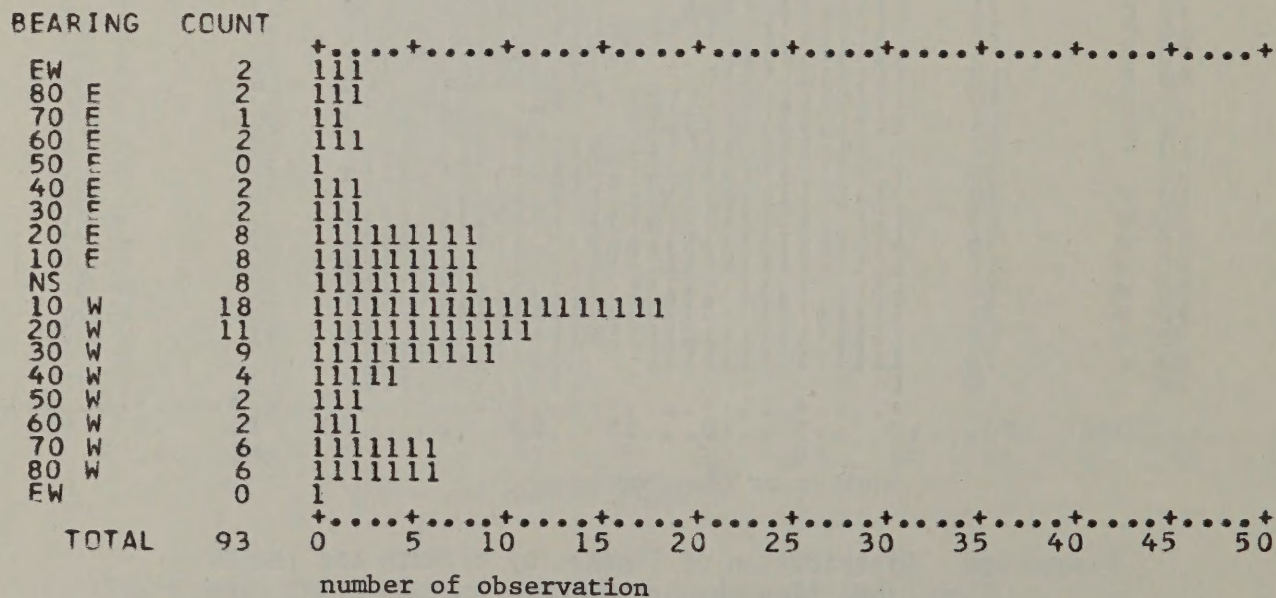


Figure 18f. Distribution of linears by azimuth and length. Linear lengths are between 3.0 and 6.0 inches.

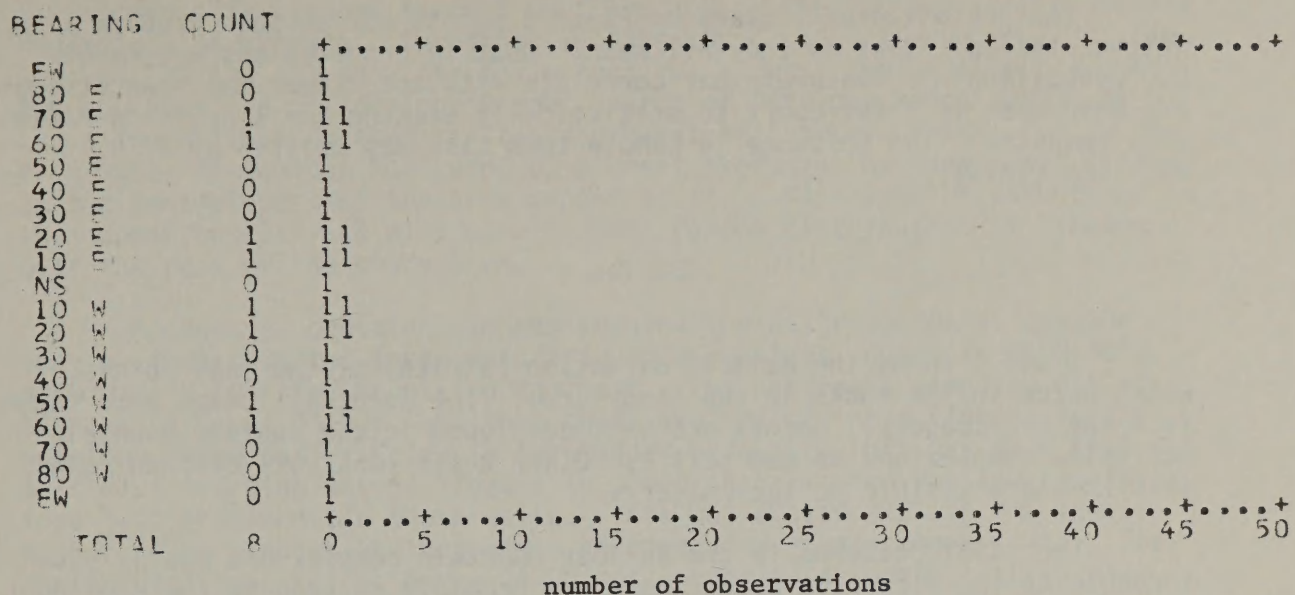


Figure 18g Distribution of linears by azimuth and length.
Linear lengths are between 6.0 and 9.0 inches.

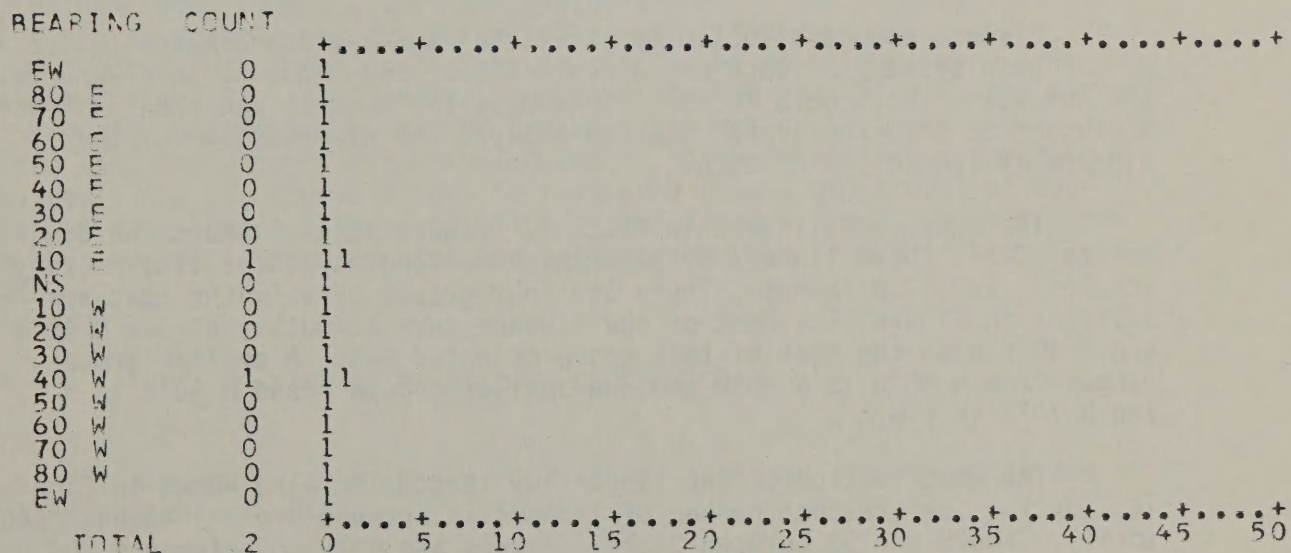


Figure 18h Distribution of linears by azimuth and length.
Linear lengths are between 9.0 and 12 inches.

The profusion of linears on Plate 3 points out another problem with interpretation. What do they all mean? Most interpretations are made by "eyeballing" in features that correlate with the linear map. An attempt has been made in this report to statistically examine the linears on Plate 3 by computer. The software to handle this task was written by J. O. Williams (1975).

JOINTING

Plate 1 shows the azimuth direction (strike) of the many joints which occur in the rocks in the study area. The joint attitudes were taken from the U-2 imagery. Joints are well developed in the Juniper Mountain tuff/flow complex and Welded tuff 1. Other units lack well defined joint sets that are visible on the imagery.

The joint patterns in the Juniper Mountain complex are mostly conformable to the flow lobe pattern and are probably related to the cooling history of these lobes. The joints in Welded tuff 1 exhibit a much more complex pattern. Major sets appear to strike east-west, northeast and north-south. The reason for this complex jointing is not clear but is obviously much more complicated than the simple pattern exhibited in the Juniper Mountain sequence.

LINEAR ANALYSIS

Plate 3 was constructed by digitizing the x-y coordinates (based on our grid system) of each end of each linear and inputting this data to the computer. With both end points known, the program can then instruct a plotter to draw the linear map and analyze the distribution of the linears by length and azimuth.

There are 750 linears in Plate 3. Figure 18(a-h) shows the distribution of all these linears by azimuth. The lengths of the linears vary between 0 and 12.0 inches. There are four groups of azimuths that are apparent in Figure 18. Most of the linears have azimuths between N 40°W and N 40°E with the peak of this group oriented N-S. A smaller group ranges from N 50°W to N 80°W and two smaller groups trend N 40°E to N 70°E and N 70°E to E-W.

The distribution of the linears by lengths is also shown in Figure 18. By far the greatest number of linears is between 1 and 3 inches (646 total). There are 93 between 3 and 6 inches and only 10 between 6 and 12 inches. This data is somewhat misleading as several long curved linears were broken into segments so that the curve could be drawn in Plate 3. Unfortunately this produced many small segments which the computer only recognizes as individual linears so there are actually more long linears than are represented in Figure 18.

Appendix C shows the map distribution of the various length linears regardless of azimuth. The short linears (0.1", 1" - 2" and 2" - 3", Figures C1, C2 and C3) show the following: a) a curvilinear pattern around the southern end of Antelope Ridge (source of Antelope Ridge tuff), b) a radial/curvilinear pattern in the southwestern quarter of the area in the flow lobes of Juniper Mountain, c) a great profusion of many small linears in the central part of the area mapped at Tt_{1a}, d) a lack of structures in the "upper basalt" and e) a more or less random distribution of linears over the rest of the study area.

Appendix D contains figures showing the distribution of various length linears in the three main azimuth directions, due west to N 60°W, N 60°W to N 60°E and N 60°E to due east. The northeast trending set of linears (Figures D1-D3) show that there are few of these linears in the Antelope Ridge tuff and few in the "upper basalt". This may show that the northeast trending set of linears is older than Tat and Tbb and are therefore less prominent in these units. This would also explain the fewer number of NE linears as they would be covered by the younger units. The northwest linear set (Figures D4-D5) is pervasive throughout the area, with a strong concentration in Tt₁ and Tt_{1a}. The northwest set of short linears is most responsible for the high concentration noted in Tt_{1a}. There are again fewer northwest linears in the upper basalt than in other units. The north-south linears (Figures D6-D8) are pervasive in all units including Tbb and are the largest group of linears. This may be the youngest set. As noted, the source for the "upper basalt" near Dougals Reservoir is separated from a flow to the east by a major north-south fault.

The overall distribution of the linears in comparison with various lithologic ages suggests that the northeast set is the oldest, the northwest set is younger and the north-south set is the youngest. Asher (1968, p. 68) noted that three fault sets in these same directions were present in the Silver City area. He believed that the NE and NS sets were mineralized and then offset by the NW system (youngest). Sorenson (1927, p. 28) noted that the primary structural trend at South Mountain was north-south. Obviously the structural trends in this area need a great deal of subsurface data before a final solution can be found. The methodology used in this report is experimental and suffers somewhat from a lack of field data.

LINEARS RELATED TO GEOCHEMISTRY

The computer program used for linear analysis also computes the following two parameters:

1. The total number of linear intersections per grid square.
2. The total length of all linear segments which pass through a grid square regardless of azimuth. The grid used is a

one inch by one inch grid which in Plate 3 is scaled so that 1 inch equals approximately 1 mile.

These two parameters are indications of ground fracturing which might be related to mineralization. Figure 19 is a map of all grid intersections and Figure 20 is a contour map of this data at the same scale as the Z-maps used in the geochemical interpretation. Figure 21 is a contour map of the lengths per grid cell at the same scale as the Z-maps.

The most obvious feature of the lengths/intersection figures is that there is a highly fractured zone approximately 4 miles wide which extends east-west across the study area. The zone of most intense fracturing is centered on Tt_{1a}. This zone lies just north of the east-west trending band of "upper basalt" which, as noted, has probably covered up a lot of older structures.

Comparison of Figure 17 (geochemical anomaly map) and Figures 20 and 21 shows no apparent relationship between high geochemical values and this highly fractured structural zone. This zone is, however, parallel to the east-west drainage divide in Tt₁ to the north. There are also more intersections north of the fractured zone than south of it. The zone of high linear intersections could be caused by:

- a. Movements in and along the proposed large caldera to the north.
- b. Structural buttressing; this area is located between the topographic highs of South Mountain (drainage divide in Tt₁ to the north and Juniper Mountain (Antelope Ridge tuff source area to the south).

It was hoped that a more definitive correlation could be obtained between the linear data and the geochemical results. Unfortunately, there are few favorable geochemical targets in the study area so such a correlation doesn't exist. This, however, does not detract from the importance of the linear study. Such a detailed analysis will undoubtedly be of great usefulness in future mineral inventory studies in other areas. This technique has great potential in solving geologic engineering problems and in geologic hazard zone mapping and should be evaluated further.

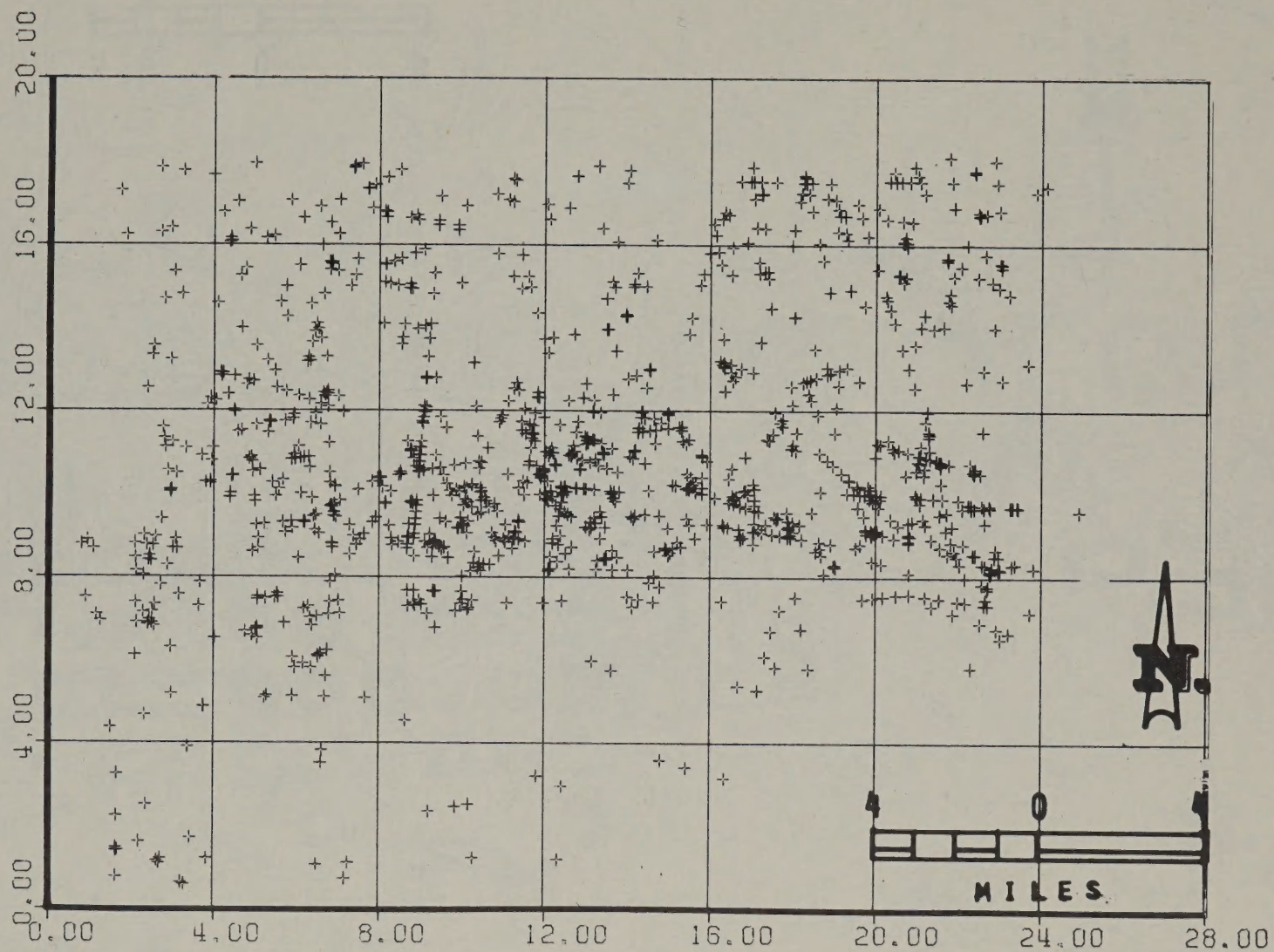


Figure 19. Map of all linear intersections.



Figure 20. Contour map of linear intersections.

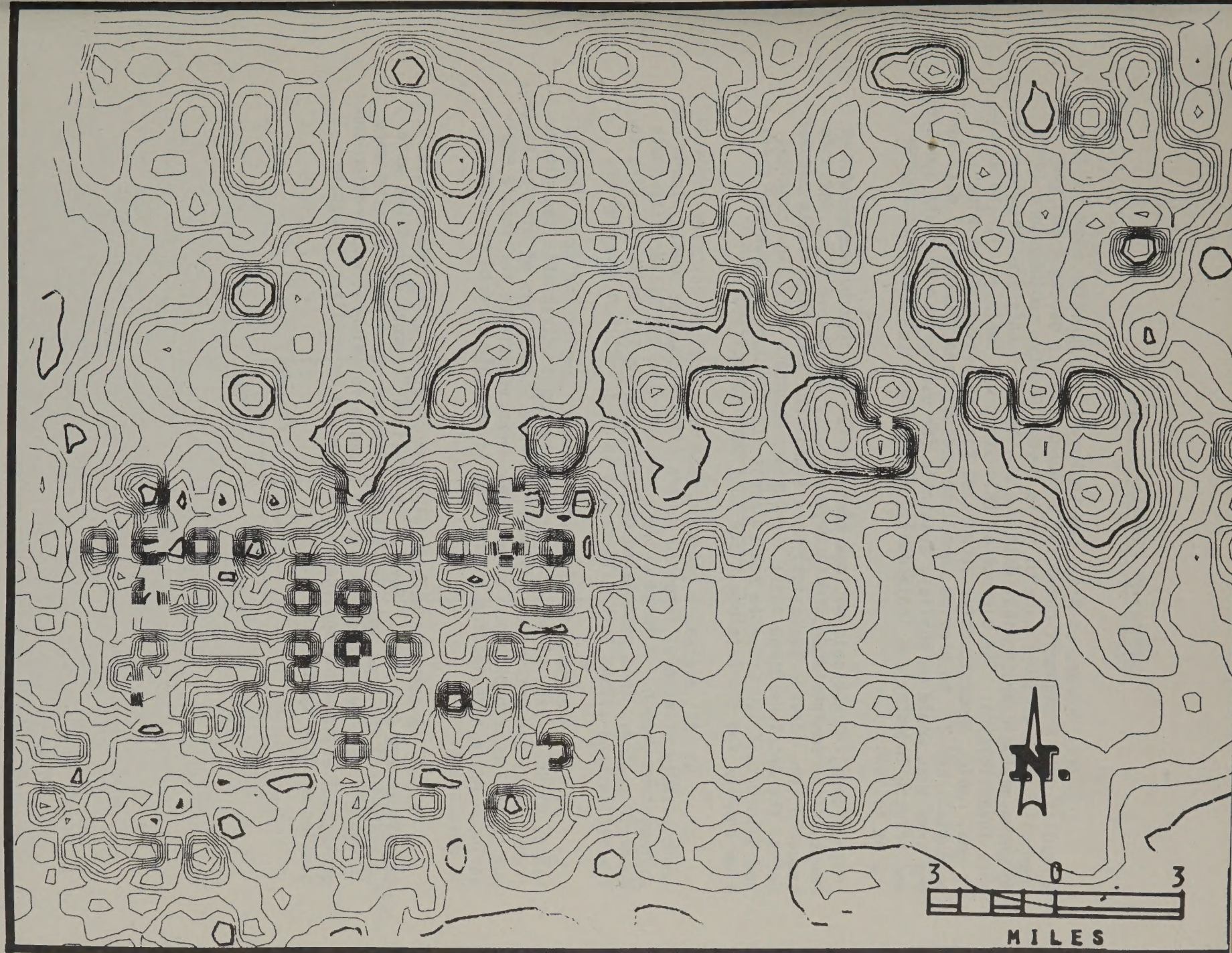


Figure 21. Contour map of total linear length per grid cell.

SUMMARY OF PROJECT RESULTS

The Idaho Bureau of Mines and Geology in conjunction with the U.S. Bureau of Land Management conducted a reconnaissance geologic and geochemical survey of 500 square miles in Owyhee County, southwestern Idaho. No known geologic/geochemical data was available in this area previous to this investigation. The purpose of this study was twofold: 1. to develop new, rapid, nondestructive techniques for the evaluation of mineral potential, and 2. to provide immediate geologic and geochemical data for the area that would be publicly available for use by federal/state agencies and private industry and individuals. The major results of the program are as follows:

1. a) A geologic map was compiled for the area between South Mountain and Juniper Mountain in Owyhee County, Idaho. A major volcanic sequence (the Idavada Volcanics) were subdivided into three field mapable units; the Antelope Ridge tuff; the Juniper Mountain tuff/flow complex, and Welded tuff 1. Probable source areas for the Juniper Mountain tuff/flow complex and the Antelope Ridge tuff were identified.

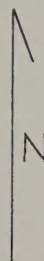
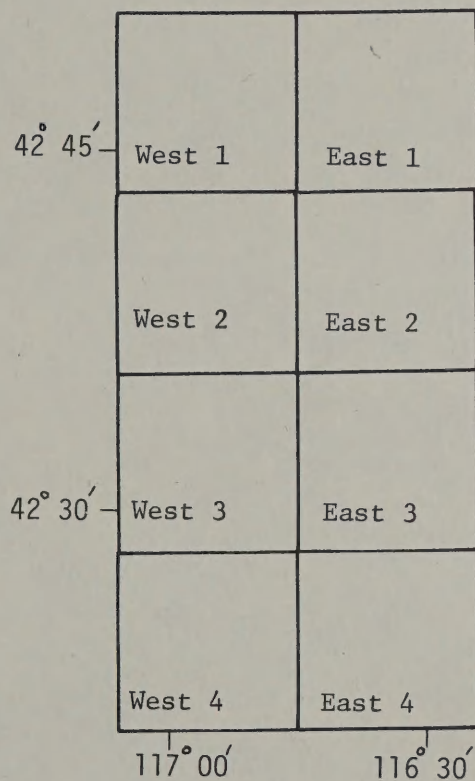
b) All available geologic data were used to describe the volcanic history of several thousand square miles in Owyhee County, Idaho and southeastern Oregon. A large caldera may exist in the Silver City-South Mountain region. This postulated collapse feature is similar in size to the Yellowstone-Island Park caldera but is 10-12 million years older.

2. a) Analysis of 583 stream sediment samples for five elements (zinc, nickel, lead, silver, copper) and two cold extractable techniques (CxHM, CxCu) did not reveal any major surface expressions of mineralization, but several possible deeper target areas were identified for future evaluation. Any mineralization in the area is probably covered by volcanics in most cases.

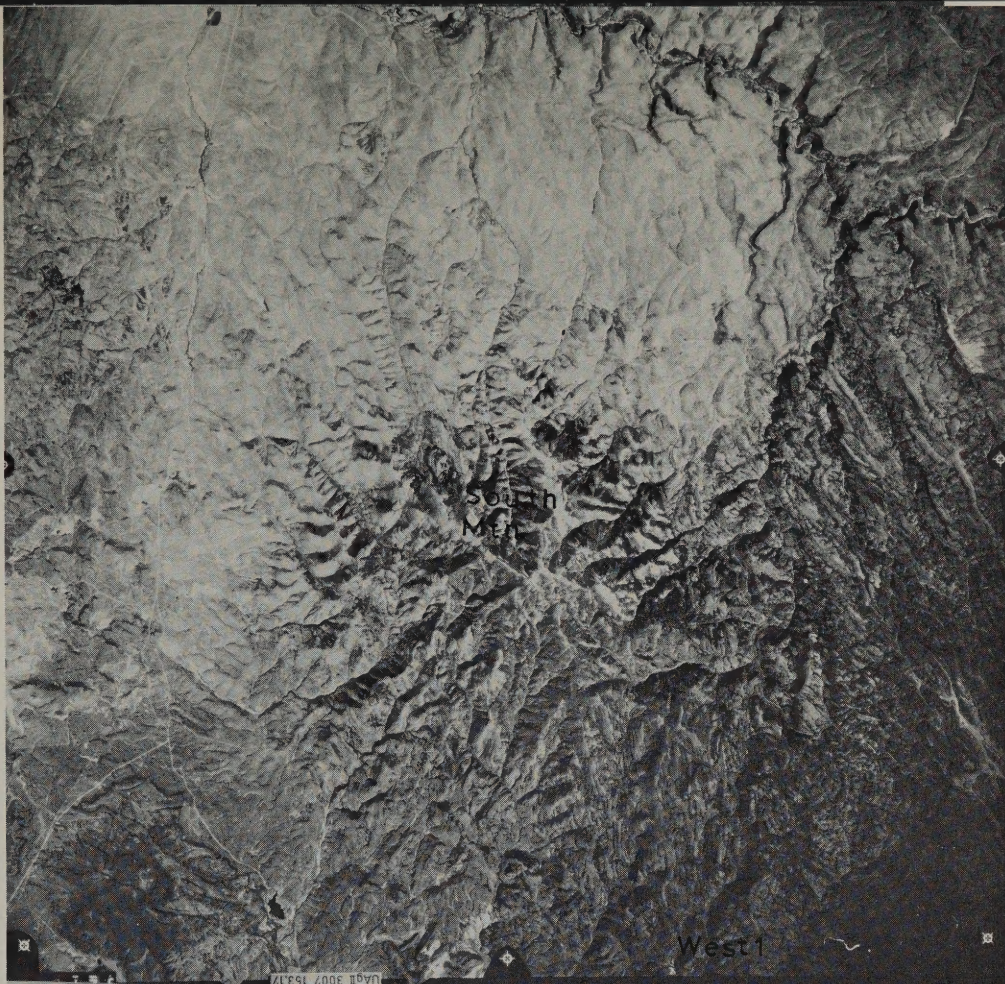
3. a) A detailed structural interpretation using new computer techniques was developed. Several major linear azimuth directions were described and analyzed and the relative ages of the linear patterns were infrared. This technique holds great promise for mineral exploration and geological engineering applications and should be utilized in future studies of this type.

APPENDIX A

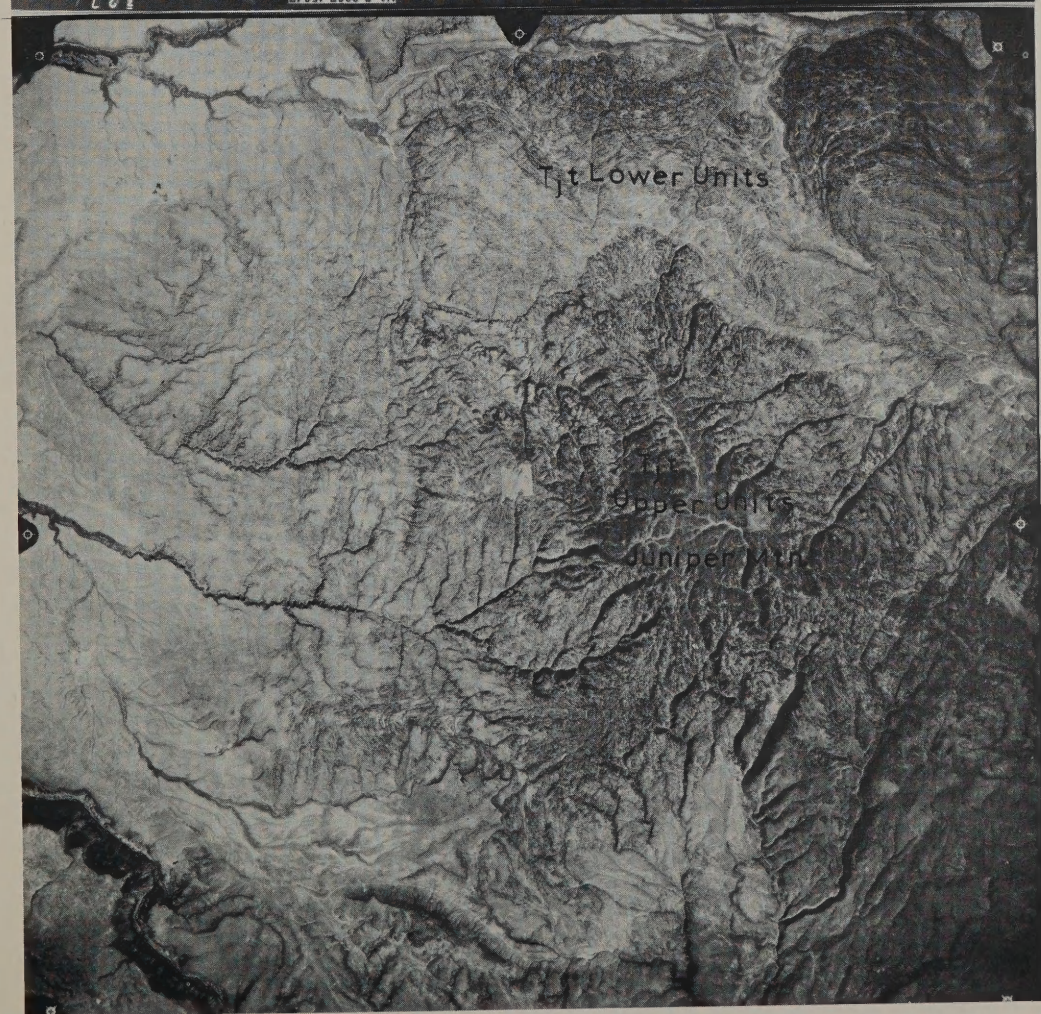
U-2 imagery of study area with geology outlined. (all unit symbols are the same as plate 1.) Note: cut out images to obtain stereo coverage of the entire study area.



Approx. scale of photos
1:250,000















APPENDIX B

ELEMENTAL ANALYSIS, SOUTH MT.-JUNIPER MT. PROJECT AREA, 1975, CUYHEE
CO., IDAHO -80MESH, SEIVED, STREAM SEDIMENT SAMPLES DIGESTED IN HOT
AQUA-REGIA AND ANALYZED BY AAS, ALL CONC. IN PP4*

NUMBER	COORDINATE		ZN	NI	PB	AG	CU	THMS	CXCU
	X	Y							
1100	46	66	35.84	13.47	14.77	0.33	40.44	1.00	0.0
1101	57	53	26.34	6.36	14.77	0.33	3.72	1.00	0.0
1102	50	50	40.21	6.96	7.54	0.20	5.42	2.00	0.0
1103	50	48	46.10	12.91	14.77	0.33	12.41	0.0	0.0
1104	58	49	104.65	19.25	24.20	0.61	34.18	2.00	0.0
1105	66	44	31.59	7.36	15.04	0.30	9.27	0.0	0.0
1106	63	16	45.77	9.30	17.53	0.50	14.31	0.0	0.0
1107	38	48	56.60	19.59	17.53	0.50	18.96	0.0	0.0
1108	25	46	25.58	6.36	10.01	0.33	6.69	1.00	0.0
1109	20	54	62.00	20.27	17.53	0.50	22.38	1.00	0.10
1110	18	58	64.70	15.42	15.04	0.50	18.49	0.0	0.0
1111	14	69	32.75	15.54	16.72	0.50	19.77	1.00	0.0
1112	19	87	41.54	6.30	12.50	0.30	13.07	0.0	0.0
1113	17	90	57.95	12.02	15.04	0.50	16.02	0.0	0.0
1114	15	42	51.35	12.02	15.04	0.30	12.22	0.0	0.10
1115	25	40	52.70	14.06	17.53	0.50	14.31	0.0	0.0
1116	33	19	22.16	5.17	7.54	0.20	4.65	0.0	0.0
1117	29	23	112.56	10.03	16.72	0.50	12.79	0.0	0.0
1118	36	26	90.56	11.13	14.77	0.49	16.09	0.0	0.0
1119	25	77	138.06	7.55	10.01	0.49	12.80	0.0	0.0
1120	23	17	34.13	7.55	14.77	0.33	9.11	0.0	0.0
1121	22	18	53.72	9.21	12.51	0.37	11.59	0.0	0.0
1122	22	21	61.49	9.93	17.09	0.49	16.58	0.0	0.0
1123	26	28	47.81	9.34	17.09	0.49	16.58	2.00	0.0
1124	27	33	51.35	12.02	15.04	0.30	17.25	0.0	0.10
1125	28	34	29.00	4.57	10.01	0.33	7.46	0.0	0.0
1126	29	36	52.70	9.98	12.50	0.30	15.16	1.00	0.0
1127	40	40	104.24	14.11	19.36	0.65	28.22	1.00	0.0
1128	40	41	93.93	12.91	19.36	0.49	23.18	3.00	0.0
1129	52	37	57.95	9.98	12.50	0.30	13.07	0.0	0.0
1130	57	30	50.47	9.93	17.09	0.33	14.93	0.0	0.0
1131	38	177	101.60	41.12	17.53	0.50	43.57	1.00	0.10
1132	12	165	102.53	41.11	10.01	0.49	41.31	1.00	0.10
1133	17	164	73.46	36.35	10.01	0.49	36.66	0.0	0.0
1134	31	153	125.33	71.60	14.77	0.65	49.85	0.0	0.0
1135	29	147	91.51	48.66	12.42	0.49	41.70	0.0	0.10
1136	24	145	147.37	91.16	14.77	0.65	50.24	3.00	0.0
1137	25	143	98.60	62.07	10.01	0.50	42.62	0.0	0.10
1138	22	157	104.60	50.24	10.01	0.50	50.60	0.0	0.10
1139	25	158	68.75	40.44	10.01	0.68	39.58	0.0	0.10
1140	13	155	47.81	16.59	10.01	0.33	42.96	1.00	0.0
1141	18	131	111.84	61.67	10.01	0.49	42.19	1.00	0.0
1142	19	132	100.10	38.89	10.01	0.50	33.12	3.00	0.10
1143	34	78	67.10	8.46	12.10	1.00	15.00	1.00	0.0
1144	249	26	36.03	40.00	19.53	0.25	15.82	1.00	0.10
1145	246	31	48.03	18.70	24.30	0.49	23.33	0.0	0.0
1147	225	28	27.23	11.32	22.28	0.14	15.26	0.50	0.0
1148	219	31	95.25	10.33	26.24	0.49	17.16	0.0	0.0
1149	211	37	44.04	8.40	16.11	0.14	13.83	1.00	0.0
1152	205	33	33.69	3.14	11.38	0.14	5.47	1.00	0.0

*Except for THMS and CXCU. Note THMS = Cold Extractable total heavy metals (CxHM).

NUMBER	COORDINATE		ZN	NI	PB	AG	CU	THMS	CXCU
	X	Y							
1153	173	31	46.51	6.48	16.11	0.14	10.60	2.00	0.0
1154	183	44	52.02	5.54	20.25	0.14	11.08	0.0	0.0
1155	159	16	36.16	7.93	16.11	0.14	9.65	1.00	0.0
1156	153	20	24.19	3.14	18.18	0.14	6.90	0.0	0.0
1157	155	56	59.91	7.46	22.28	0.32	12.41	5.00	0.0
1158	156	47	60.38	6.48	18.18	0.32	17.63	3.00	0.0
1159	167	48	99.05	5.54	18.18	0.14	12.03	0.50	0.0
1160	159	34	74.63	9.39	20.25	0.14	18.58	1.00	0.0
1161	160	33	39.58	5.07	18.18	0.14	7.75	1.00	0.0
1162	162	22	50.98	5.07	14.00	0.14	10.60	1.00	0.0
1163	164	19	11.33	2.56	4.03	0.11	3.52	1.00	0.0
1164	167	12	67.79	8.87	22.28	0.14	17.16	1.00	0.0
1165	172	9	62.71	11.13	14.57	0.34	20.24	0.50	0.0
1166	170	54	73.63	8.40	24.30	0.32	17.63	0.0	0.0
1167	167	58	33.69	4.60	18.18	0.14	9.65	0.0	0.10
1168	161	61	25.71	3.14	14.00	0.14	7.37	1.00	0.0
1169	162	66	40.15	6.01	20.25	0.14	10.13	1.00	0.0
1170	42	170	70.23	28.76	10.89	0.67	28.27	0.50	0.0
1172	39	165	61.90	21.66	14.00	0.49	29.03	0.50	0.0
1173	40	159	54.02	26.73	11.88	0.14	31.88	0.0	0.0
1176	262	73	50.98	11.32	14.00	0.32	17.16	0.50	0.0
1177	249	76	32.64	6.01	22.28	0.14	13.83	1.00	0.0
1178	33	82	49.90	8.20	17.10	0.50	15.13	2.00	0.0
1179	35	77	38.15	6.48	20.25	0.32	16.68	0.50	0.0
1180	33	81	75.08	11.13	16.64	0.34	21.02	2.00	0.0
2101	29	114	63.39	31.78	9.77	0.50	31.89	0.50	0.10
2102	29	113	47.05	10.53	7.54	0.33	18.62	0.0	0.0
2103	21	112	64.91	8.15	14.77	0.49	16.97	1.00	0.10
2104	22	111	68.33	17.18	12.42	0.49	26.57	0.0	0.10
2105	24	113	78.59	10.53	14.77	0.49	22.79	2.00	0.10
2106	25	113	87.35	30.41	12.50	0.50	31.79	4.00	0.0
2107	22	105	48.76	7.55	17.09	0.33	14.45	0.0	0.0
2108	32	102	62.15	15.13	17.53	0.30	21.91	2.00	0.0
2109	59	102	70.99	44.42	12.42	0.49	37.43	2.00	0.10
2110	55	97	59.02	44.74	7.38	0.25	32.97	0.50	0.20
2111	64	103	73.85	11.93	17.53	0.30	18.49	2.00	0.0
2112	64	106	51.80	11.35	22.14	0.25	13.27	2.00	0.10
2113	61	109	80.30	10.13	14.77	0.49	16.09	3.00	0.0
2114	60	108	100.40	54.66	10.01	0.30	42.01	11.00	0.10
2115	43	107	71.94	46.27	14.63	0.50	35.22	1.00	0.10
2116	49	108	72.70	10.13	19.36	0.49	18.23	3.00	0.0
2117	49	109	257.90	11.93	32.54	0.50	12.70	2.00	0.0
2118	54	119	84.20	16.44	17.53	0.50	19.90	2.00	0.0
2119	55	118	93.22	18.68	19.36	0.49	28.61	3.00	0.0
2120	56	115	62.82	10.70	17.10	0.25	18.66	3.00	0.10
2121	56	113	51.23	9.37	17.10	0.25	17.29	3.00	0.0
2122	64	116	112.55	15.81	22.52	0.50	27.99	7.00	0.0
2123	64	117	103.55	61.38	7.52	0.50	43.72	1.00	0.0
2124	13	116	82.85	37.34	12.50	0.68	37.83	0.0	0.0
2125	73	101	78.40	57.44	9.77	0.25	37.08	0.50	0.10
2126	75	100	0.06	38.07	12.50	0.50	27.55	0.0	0.0

NUMBER	COORDINATE X Y		ZN	NI	PB	AG	CU	THMS	CXCU
2127	78	104	73.85	52.12	12.50	0.68	47.51	0.0	0.0
2128	76	111	88.70	93.83	10.01	0.30	56.92	3.00	0.0
2129	79	105	81.25	8.99	17.09	0.33	17.36	0.0	0.0
2130	68	121	99.05	65.27	12.50	0.50	44.10	0.0	0.0
2131	68	122	99.87	45.85	7.54	0.33	34.52	0.0	0.0
2132	68	143	95.90	73.04	10.01	0.50	51.75	9.00	0.0
2133	68	163	69.28	48.70	7.54	0.33	39.18	0.0	0.10
2134	68	140	91.85	70.73	10.01	0.50	44.54	0.0	0.10
2135	69	130	91.85	69.15	10.01	0.50	46.63	4.00	0.10
2136	64	125	92.27	66.18	12.42	0.49	51.11	2.00	0.10
2137	70	125	31.25	50.88	14.77	0.49	42.96	0.0	0.10
2138	66	129	89.04	79.38	9.77	0.50	49.43	0.50	0.10
2139	65	120	82.96	51.64	10.01	0.33	44.71	1.00	0.10
2140	68	149	90.05	101.81	10.01	0.50	57.30	1.00	0.10
2141	69	149	71.15	40.17	10.01	0.50	32.88	1.00	0.10
2142	29	179	90.05	68.31	10.01	0.68	50.87	1.00	0.10
2143	33	178	82.85	38.07	10.01	0.50	38.27	1.00	0.10
2144	34	177	89.61	55.73	9.77	0.50	43.06	0.50	0.10
2145	35	176	34.20	35.24	12.50	0.50	37.45	0.0	0.0
2146	31	167	55.03	28.46	9.77	0.50	29.64	0.50	0.10
2147	32	165	68.00	29.04	7.52	0.50	52.19	0.0	0.0
2148	27	169	73.46	25.61	10.01	0.33	45.58	0.0	0.10
2149	29	161	85.55	40.91	7.52	0.50	46.25	1.00	0.0
2150	28	178	72.50	33.87	10.01	0.30	34.15	2.00	0.0
2151	17	122	79.70	29.78	10.01	0.30	30.41	0.0	0.0
2152	19	133	85.55	32.51	12.50	0.50	32.06	1.00	0.10
2153	18	134	94.55	61.38	10.01	0.50	35.80	0.50	0.10
2154	31	131	93.20	23.06	15.04	0.50	13.52	0.0	0.10
2155	35	126	68.71	80.33	12.15	0.50	51.78	2.00	0.10
2156	36	141	79.73	54.97	9.77	0.50	40.42	2.00	0.10
2157	36	136	85.05	70.36	9.77	0.50	43.85	0.50	0.10
2158	33	122	102.20	48.78	10.01	0.30	41.63	1.00	0.0
2159	37	122	72.50	20.43	12.50	0.50	24.74	0.0	0.0
2160	43	129	61.49	39.01	9.77	0.50	44.14	2.00	0.10
2161	49	129	98.16	30.84	12.42	0.49	42.19	0.0	0.10
2162	50	131	52.56	39.77	7.38	0.25	24.54	0.50	0.10
2163	52	130	93.20	58.34	12.50	0.50	43.72	3.00	0.0
2164	53	128	87.35	81.56	10.01	0.50	59.45	1.00	0.0
2165	52	127	80.30	55.35	17.09	0.49	40.44	0.50	0.0
2166	47	123	66.62	47.65	7.38	0.25	28.56	0.50	0.10
2167	47	121	93.20	16.44	12.50	0.50	24.74	0.0	0.0
2168	46	119	63.95	44.37	7.52	0.30	29.53	1.00	0.0
2169	50	138	126.05	62.12	10.01	0.50	54.33	0.0	0.10
2170	49	137	66.65	52.35	7.52	0.50	30.41	0.0	0.0
2171	46	141	62.15	33.87	7.52	0.30	26.34	0.0	0.10
2172	50	149	60.80	42.27	7.52	0.30	32.06	2.00	0.10
2173	51	150	40.52	43.74	12.50	0.50	17.19	0.0	0.0
2174	57	144	64.91	45.85	7.54	0.49	42.58	0.0	0.0
2175	56	143	82.85	49.52	7.52	0.50	42.84	6.00	0.0
2176	51	136	87.35	59.07	7.52	0.50	43.28	6.00	0.10
2177	48	140	52.94	38.15	19.36	0.33	25.70	0.0	0.0

NUMBER	COORDINATE X Y		ZN	NI	PB	AG	CU	THMS	CXCU
2178	53	166	82.01	17.44	25.86	0.33	19.49	1.00	0.0
2179	55	167	50.45	8.73	15.04	0.50	11.93	5.00	0.0
2181	225	97	33.69	4.60	16.11	0.14	9.65	0.0	0.10
2182	212	120	58.64	7.51	18.20	0.52	10.89	0.0	0.0
2183	212	114	47.56	6.43	22.28	0.32	16.21	3.00	0.10
2184	208	131	36.63	5.54	13.18	0.32	11.55	1.00	0.0
2185	201	142	57.44	6.95	20.25	0.14	13.36	0.50	0.0
2186	222	124	42.14	6.43	20.25	0.49	16.68	2.00	0.10
2187	228	112	49.90	8.03	15.26	0.36	14.12	1.00	0.0
2188	224	116	58.64	11.55	15.26	0.36	14.83	1.00	0.0
2189	228	109	52.02	8.87	20.25	0.14	19.53	2.00	0.0
2190	225	108	81.61	10.20	35.00	2.08	17.25	0.50	0.0
2191	234	103	17.73	3.61	9.72	0.14	7.37	5.00	0.0
2192	239	108	34.64	5.54	18.18	0.32	10.60	0.0	0.0
2193	240	110	16.68	4.08	9.72	0.14	8.23	2.00	0.10
2194	236	126	35.84	7.04	19.63	0.21	9.65	2.00	0.0
2195	231	124	50.54	9.53	21.15	0.36	12.83	2.00	0.0
2196	235	122	16.27	5.95	7.38	0.25	6.12	2.00	0.10
2197	253	122	46.86	11.04	19.63	0.36	16.59	4.00	0.0
2198	258	132	44.04	6.01	20.25	0.14	13.83	3.00	0.10
2199	250	132	40.62	7.46	20.25	0.32	14.31	2.00	0.0
2200	258	135	59.21	13.06	18.20	0.36	17.92	4.00	0.0
2201	250	106	52.50	7.46	18.18	0.32	16.63	16.00	0.0
2202	235	27	64.91	13.06	16.68	0.32	18.87	1.00	0.10
2203	231	22	41.57	6.48	22.28	0.14	14.78	0.0	0.10
2204	225	19	48.00	12.02	15.26	0.36	16.59	2.00	0.0
2205	229	19	44.39	11.04	18.20	0.36	13.36	2.00	0.0
2206	229	17	32.17	6.95	16.11	0.14	12.41	5.00	0.0
2207	251	17	63.80	39.24	24.30	0.14	25.71	9.00	0.10
2208	252	19	57.31	37.03	21.15	0.36	21.43	5.00	0.0
2209	256	21	31.69	16.21	11.88	0.14	12.83	5.00	0.10
2210	254	29	32.17	15.22	22.28	0.14	14.78	3.00	0.10
2211	263	35	34.64	15.74	22.28	0.14	14.78	10.00	0.10
2212	255	38	40.62	17.71	18.18	0.32	19.53	7.00	0.10
2213	242	48	42.14	15.22	22.28	0.32	17.16	10.00	0.10
2214	242	52	43.57	22.69	24.30	0.14	20.01	11.00	0.10
2215	234	56	34.16	26.73	20.25	0.14	20.01	4.00	0.0
2216	225	52	67.79	48.89	25.48	0.35	32.31	7.00	0.10
2217	227	59	32.64	9.86	13.18	0.32	16.68	5.00	0.10
2218	225	63	30.17	6.48	11.88	0.14	11.03	5.00	0.0
2219	226	64	26.66	5.54	9.72	0.14	10.13	6.00	0.0
2220	233	62	58.57	10.62	19.07	0.26	15.75	11.00	0.0
2221	254	64	55.44	30.31	22.28	0.14	23.56	3.00	0.10
2222	254	65	36.72	23.43	24.31	0.36	20.57	9.00	0.10
2223	255	57	43.09	17.71	28.22	0.14	20.48	10.00	0.10
2224	240	75	46.51	16.21	15.11	0.14	13.58	20.00	0.0
2225	241	74	63.01	27.25	22.67	0.52	25.23	3.00	0.10
2226	240	67	50.47	27.25	18.20	0.52	22.67	5.00	0.10
2228	245	71	29.76	12.50	14.63	0.25	12.19	0.50	0.10
2229	244	68	48.51	22.69	20.25	0.32	21.43	3.00	0.0
2230	246	66	71.37	43.75	18.20	0.52	36.16	9.00	0.0

NUMBER	COORDINATE		ZN	NI	PR	AG	CU	THMS	CXCU
	X	Y							
2231	248	67	42.14	13.76	19.18	0.32	20.96	7.00	0.0
2232	246	84	75.30	14.82	26.91	0.24	23.10	7.00	0.0
2233	237	79	28.13	5.54	14.00	0.14	9.65	3.00	0.0
2234	237	85	25.23	6.48	11.88	0.32	9.18	2.00	0.10
2235	72	24	32.99	10.00	12.15	0.25	16.90	0.50	0.10
2236	73	25	49.90	12.02	22.67	0.36	20.67	7.00	0.10
2237	77	16	34.64	3.61	16.11	0.14	9.18	5.00	0.10
2238	84	10	11.90	2.70	5.00	0.25	2.20	0.50	0.0
2239	94	25	37.74	9.02	13.74	0.36	12.60	4.00	0.0
2240	97	20	52.97	6.95	16.11	0.14	9.18	6.00	0.0
2241	106	13	27.29	7.60	9.77	0.25	9.35	0.50	0.10
2242	106	12	49.33	11.04	15.26	0.52	12.12	4.00	0.0
2243	95	31	55.92	23.68	20.25	0.14	17.16	5.00	0.10
2244	94	34	26.72	7.00	9.77	0.25	8.27	2.00	0.0
2245	92	35	25.71	6.01	18.18	0.32	11.55	3.00	0.10
2246	94	37	58.96	7.93	20.25	0.32	17.16	11.00	0.0
2247	92	45	37.36	16.20	14.63	0.25	15.82	2.00	0.0
2248	94	44	70.74	10.33	24.30	0.32	23.33	7.00	0.10
2249	85	39	24.82	8.20	12.15	0.25	11.51	0.50	0.0
2250	76	38	47.43	11.30	12.15	0.50	16.21	2.00	0.10
2251	88	42	35.63	6.95	24.30	0.14	15.26	6.00	0.0
2252	101	30	34.13	8.80	9.77	0.25	14.05	0.50	0.10
2253	78	46	29.76	10.70	12.15	0.25	11.51	4.00	0.0
2254	84	54	31.66	18.10	9.77	0.50	18.37	0.50	0.0
2255	177	68	28.62	5.54	15.26	0.21	8.13	4.00	0.0
2256	170	66	35.84	6.67	11.21	0.20	9.72	5.00	0.0
2257	175	67	45.53	7.51	9.97	0.20	10.66	5.00	0.0
2258	172	75	58.96	7.93	18.18	0.32	19.06	6.00	0.10
2259	170	76	51.99	9.20	13.85	0.20	12.12	4.00	0.0
2260	173	82	46.10	7.04	15.26	0.21	7.66	2.00	0.0
2261	168	83	70.80	8.50	16.68	0.36	10.89	3.00	0.0
2262	163	88	73.68	9.39	28.22	0.32	18.11	10.00	0.0
2263	163	95	47.56	5.07	16.11	0.14	11.55	7.00	0.10
2264	170	87	65.67	6.67	11.21	0.20	10.66	7.00	0.0
2265	173	81	53.70	9.20	12.53	0.20	15.50	9.00	0.0
2266	180	88	99.05	5.54	28.22	0.14	11.08	5.00	0.0
2267	169	114	75.68	11.32	22.28	0.14	16.21	6.00	0.10
2268	175	115	60.92	9.20	15.23	0.30	15.50	7.00	0.0
2269	176	114	75.36	8.36	15.23	0.20	11.65	11.00	0.0
2270	176	109	41.10	4.60	14.00	0.14	11.08	7.00	0.0
2271	123	22	63.20	10.85	15.23	0.20	18.98	10.00	0.10
2274	122	11	82.77	7.51	12.53	0.20	10.66	7.00	0.0
2275	187	65	47.81	7.51	11.21	0.30	17.99	2.00	0.0
2276	216	147	58.45	12.54	11.21	0.20	14.04	2.00	0.0
2277	216	151	36.98	6.67	15.23	0.30	14.04	1.00	0.0
2278	215	160	32.42	5.02	11.21	0.20	11.65	0.50	0.0
2279	212	182	49.33	9.53	18.20	0.36	15.16	0.50	0.0
2280	209	171	47.81	12.54	13.85	0.40	22.46	1.00	0.0
2281	208	174	57.88	11.69	11.21	0.20	20.95	2.00	0.0
2282	206	181	31.85	5.02	9.97	0.11	9.72	0.50	0.0
2284	200	121	48.38	6.67	11.21	0.20	12.12	0.50	0.0

NUMBER	COORDINATE X Y		ZN	NI	PB	AG	CU	THMS	CXCU
2285	192	128	54.84	9.02	16.68	0.36	13.83	3.00	0.10
2286	190	130	29.57	5.87	13.85	0.20	10.19	0.0	0.0
2287	183	136	46.10	11.69	15.23	0.40	24.43	1.00	0.10
2289	195	114	54.27	4.17	9.97	0.20	7.32	0.50	0.0
2290	199	105	40.40	9.20	11.21	0.20	12.59	0.50	0.10
2291	180	124	63.01	9.53	16.68	0.36	16.59	3.50	0.10
2292	177	130	57.31	11.55	21.15	0.36	18.11	1.00	0.0
2293	188	114	49.90	9.02	21.15	0.36	12.12	0.50	0.10
2294	143	130	87.14	13.39	15.23	0.40	20.95	2.00	0.0
2295	148	127	74.60	14.04	18.20	0.52	23.43	2.00	0.0
2296	158	122	50.85	6.67	12.53	0.30	13.10	0.50	0.10
2297	151	119	62.44	7.04	15.26	0.21	9.94	0.50	0.0
2298	150	117	60.16	9.20	12.53	0.40	16.02	0.50	0.10
2299	148	115	73.46	10.85	12.53	0.40	17.99	2.00	0.10
2300	153	112	90.94	13.39	12.53	0.40	22.46	0.0	0.0
2301	155	111	69.85	12.54	13.85	0.30	17.99	1.00	0.0
2302	157	109	75.93	9.20	15.23	0.30	16.49	1.00	0.10
2303	143	118	91.51	12.54	15.23	0.50	27.49	5.00	0.0
2304	142	124	106.33	9.20	13.85	0.30	16.49	0.50	0.0
2305	145	135	56.74	12.02	21.15	0.52	22.38	4.00	0.10
2306	136	143	56.74	7.04	19.63	0.36	15.35	0.50	0.10
2307	141	142	63.77	9.02	21.15	0.52	15.64	0.0	0.0
2308	137	175	53.70	7.51	18.20	0.36	13.17	0.0	0.0
2309	140	170	43.06	7.04	18.20	0.36	13.36	0.0	0.0
2310	143	165	58.64	11.55	22.67	0.67	27.99	1.00	0.10
2311	145	158	79.92	13.06	21.15	0.52	23.43	1.00	0.10
2312	137	158	53.13	8.36	13.85	0.30	16.02	1.00	0.0
2313	62	83	57.31	11.69	13.85	0.30	18.98	1.00	0.10
2314	63	84	59.02	8.36	12.53	0.30	16.02	1.00	0.10
2315	71	87	44.39	4.17	8.72	0.12	6.81	4.00	0.0
2316	72	86	56.17	9.20	13.85	0.30	16.49	1.00	0.10
2317	71	92	81.44	15.92	13.85	0.40	26.97	4.00	0.0
2318	58	89	61.11	12.02	18.20	0.52	16.59	3.00	0.0
2319	59	90	82.77	11.69	12.53	0.40	22.46	1.00	0.10
2320	39	82	57.31	38.06	9.37	0.36	27.23	0.0	0.0
2321	31	94	60.54	10.00	19.63	0.21	15.16	1.00	0.0
2322	56	76	44.96	12.54	13.85	0.30	18.46	0.50	0.0
2324	41	83	83.34	44.64	11.21	0.40	40.93	1.00	0.10
2325	68	75	110.32	13.39	11.21	0.40	27.49	11.00	0.0
2326	59	17	53.70	10.85	16.63	0.40	18.98	1.00	0.0
2327	61	18	46.67	10.00	13.85	0.30	17.01	3.00	0.0
2328	60	20	36.41	8.36	12.53	0.30	15.03	3.00	0.0
2329	61	33	68.71	12.54	18.09	0.30	18.98	3.00	0.0
2330	63	27	28.43	7.51	9.97	0.30	12.12	0.50	0.0
2331	43	27	49.71	10.00	11.21	0.40	14.56	0.50	0.0
2332	38	38	52.56	9.20	12.53	0.40	14.56	0.50	0.10
2333	11	29	53.70	11.69	12.53	0.30	21.42	1.00	0.10
2334	18	34	51.42	10.00	11.21	0.30	19.45	1.00	0.10
2335	75	63	52.37	34.96	16.68	0.52	26.94	0.50	0.10
2336	75	61	36.98	19.31	12.53	0.40	17.99	0.50	0.0
2337	133	81	47.81	9.20	11.21	0.40	17.01	0.50	0.0

NUMBER	COORDINATE		ZN	NI	PB	AG	CU	THMS	CXCU
	X	Y							
2338	130	103	33.56	5.87	11.21	0.20	9.72	0.50	0.0
2339	134	83	57.88	9.20	13.85	0.30	14.04	2.00	0.0
2340	138	80	58.45	10.00	13.85	0.30	17.48	0.50	0.0
2341	127	85	62.06	10.00	13.85	0.30	17.99	2.00	0.0
2342	128	86	43.82	6.67	11.21	0.20	12.12	1.00	0.0
2343	122	71	39.83	24.43	11.21	0.20	21.94	1.00	0.0
2344	165	113	47.81	6.67	9.97	0.30	12.59	2.00	0.0
2345	166	120	46.67	7.51	13.85	0.30	15.03	2.00	0.0
2346	87	47	38.12	7.51	13.85	0.20	13.10	0.0	0.0
2347	164	103	122.29	8.36	18.09	0.30	12.12	0.50	0.0
2348	167	100	86.57	7.51	15.23	0.30	14.56	0.50	0.0
3100	96	131	113.75	9.30	20.03	0.50	18.49	1.00	0.0
3101	120	113	60.66	6.69	15.04	0.30	12.22	0.0	0.0
3102	112	122	84.05	8.63	17.53	0.50	21.05	1.00	0.0
3103	121	112	47.43	9.40	14.63	0.25	12.19	2.00	0.0
3104	119	103	81.82	10.70	14.63	0.50	16.21	2.00	0.0
3105	119	105	92.75	7.95	12.50	0.30	13.96	3.00	0.10
3106	113	104	85.43	13.74	17.09	0.49	20.65	4.00	0.0
3107	103	147	115.25	7.95	25.02	0.30	35.21	20.00	0.20
3108	92	152	88.90	8.42	19.36	0.33	17.74	4.00	0.0
3109	92	156	72.95	8.63	20.03	0.50	19.82	0.0	0.10
3110	90	159	47.21	6.69	20.03	0.30	10.93	3.00	0.10
3111	96	164	39.26	21.90	7.38	0.25	18.66	0.50	0.10
3112	94	178	79.73	10.70	14.63	0.25	17.29	3.00	0.10
3113	95	176	74.41	18.01	14.77	0.33	18.62	0.0	0.0
3114	96	163	95.60	11.34	20.03	0.50	19.82	20.00	0.10
3115	84	112	91.70	8.80	12.15	0.25	14.35	2.00	0.0
3116	82	111	63.39	40.70	5.77	0.50	32.23	2.00	0.10
3117	81	119	95.60	41.90	15.04	0.68	47.46	6.00	0.10
3118	82	121	70.61	61.10	7.38	0.50	43.06	0.50	0.10
3119	83	120	57.38	38.70	7.38	0.50	31.89	2.00	0.0
3120	78	128	98.16	63.04	12.42	0.49	51.98	0.0	0.10
3121	57	112	80.90	51.79	12.50	0.50	46.23	0.0	0.10
3122	87	142	71.13	33.40	7.38	0.50	37.48	0.50	0.10
3123	88	143	92.27	25.61	17.09	0.49	30.74	0.0	0.0
3124	89	140	68.71	9.40	19.58	0.50	15.13	2.00	0.0
3125	87	133	97.40	35.49	14.77	0.49	38.70	0.0	0.0
3126	84	137	92.27	56.87	12.42	0.49	45.56	0.0	0.0
3127	86	128	114.31	9.56	19.36	0.49	13.62	0.0	0.0
3128	36	124	102.53	10.51	19.36	0.49	21.14	1.00	0.0
3129	95	96	40.21	3.04	14.77	0.33	16.53	1.00	0.0
3130	118	126	82.70	9.98	15.04	0.30	12.60	7.00	0.0
3131	108	134	64.91	9.27	14.77	0.33	12.02	3.00	0.0
3132	102	135	91.25	12.70	17.53	0.50	21.91	20.00	0.0
3133	116	131	51.23	8.80	12.15	0.25	13.66	2.00	0.0
3134	90	98	81.20	6.01	15.04	0.30	8.04	0.0	0.0
3135	100	103	47.43	8.20	9.77	0.25	9.74	1.00	0.0
3136	77	106	67.40	7.95	12.50	0.30	10.51	1.00	0.0
3137	143	104	70.10	7.36	12.50	0.30	10.98	0.0	0.0
3133	83	99	56.93	7.60	12.15	0.25	11.11	2.00	0.0
3139	101	112	40.21	6.80	12.42	0.33	13.67	0.50	0.10

NUMBER	COORDINATE		ZN	NI	PB	AG	CJ	TMS	CXCU
	X	Y							
3140	108	110	34.05	13.64	20.03	0.68	27.51	3.00	0.0
3141	94	109	102.53	6.80	14.77	0.33	10.37	5.00	1.00
3142	97	116	98.60	13.64	17.53	0.50	16.40	4.00	0.0
3143	98	116	91.25	8.89	15.04	0.30	11.36	3.00	0.0
3144	100	118	89.90	10.89	15.04	0.50	26.66	9.00	1.00
3145	102	123	38.40	10.89	17.53	0.50	19.34	5.00	0.0
3146	103	122	70.61	7.00	9.77	0.25	9.74	2.00	0.0
3147	105	125	106.52	7.60	14.63	0.25	10.82	2.00	0.0
3148	106	124	75.85	9.56	17.53	0.50	14.69	3.00	0.0
3149	132	124	64.91	14.78	17.09	0.33	19.83	4.00	0.0
3150	131	123	59.59	11.30	12.15	0.25	21.60	3.00	0.0
3151	125	127	60.73	14.21	19.36	0.49	34.91	5.00	0.10
3152	129	123	36.03	5.20	12.15	0.25	10.04	0.50	0.05
3153	124	135	64.70	10.22	17.53	0.50	15.54	2.00	0.0
3154	115	148	51.23	8.80	14.63	0.25	14.74	2.00	0.0
3155	120	164	73.27	13.80	17.10	0.50	19.44	3.00	0.0
3156	122	152	25.83	8.89	12.50	0.30	6.80	0.0	0.0
3157	128	141	38.70	10.22	12.50	0.30	9.27	0.0	0.0
3158	126	146	21.21	9.84	10.01	0.33	7.07	3.00	0.0
3159	117	155	85.55	22.67	20.03	0.50	24.09	5.00	0.0
3160	115	154	64.15	8.20	14.63	0.50	14.74	3.00	0.0
3161	113	160	36.90	12.98	22.52	0.50	20.20	4.00	0.0
3162	113	163	63.35	15.73	17.53	0.50	16.87	4.00	0.10
3163	114	162	64.70	37.87	15.04	0.50	27.89	4.00	0.0
3164	111	170	48.00	15.60	12.15	0.50	18.37	3.00	0.0
3165	113	168	44.96	8.80	9.77	0.25	15.82	2.00	0.0
3166	112	175	47.81	14.78	14.77	0.49	14.06	2.00	0.0
3167	106	175	70.10	12.98	20.03	0.30	20.20	4.00	0.0
3168	102	180	67.40	15.07	20.03	0.50	21.91	0.50	0.0
3169	101	163	113.75	12.98	17.53	0.50	39.20	12.00	0.20
3170	100	162	81.25	6.80	19.36	0.49	11.63	3.00	0.0
3171	88	165	75.17	21.24	14.77	0.65	24.05	2.00	0.10
3172	84	155	85.55	64.28	10.01	0.50	51.07	2.00	0.10
3173	83	156	62.00	32.74	15.04	0.50	29.22	0.0	0.10
3174	76	156	84.05	33.50	10.01	0.50	25.33	20.00	0.10
3175	175	157	41.16	20.00	7.38	0.25	21.21	0.50	0.0
3176	69	155	66.05	34.92	12.50	0.30	38.25	0.0	0.10
3177	70	156	77.00	45.37	17.53	0.63	45.26	3.00	0.10
3178	63	164	59.30	24.85	12.50	0.50	25.80	7.00	0.0
3179	64	163	70.10	14.31	15.04	0.50	21.53	2.00	0.0
3180	85	177	52.13	25.80	12.42	0.49	24.82	0.0	0.0
3181	81	175	57.95	17.82	10.01	0.50	21.91	0.0	0.0
3182	82	180	73.46	21.24	14.77	0.49	24.44	0.0	0.0
3183	72	173	163.55	24.85	27.51	0.63	29.60	1.00	0.0
3184	63	175	84.05	18.49	17.53	0.50	30.08	6.00	0.0
3185	73	170	61.49	16.11	12.42	0.49	32.39	0.0	0.10
3186	13	93	50.00	11.65	15.04	0.30	16.40	0.0	0.0
3187	18	92	32.99	8.20	9.77	0.25	14.35	0.50	0.0
3188	29	59	66.05	12.98	15.04	0.30	17.25	1.00	0.0
3189	28	60	44.20	10.00	9.77	0.25	14.05	2.00	0.0
3190	38	54	78.59	12.98	17.09	0.49	20.27	1.00	0.0

NUMBER	COORDINATE X Y		ZN	NI	PR	AC	CU	THMS	CXCU
3191	45	53	67.40	10.89	17.53	0.30	16.40	5.00	0.0
3192	50	55	18.74	2.70	7.38	0.25	8.66	0.50	0.0
3193	53	54	31.59	6.90	12.50	0.30	8.42	0.0	0.0
3194	33	72	59.02	31.50	12.15	0.25	11.90	0.0	0.10
3201	235	86	19.31	4.50	9.37	0.36	6.42	11.00	0.0
3202	236	101	36.16	6.01	18.18	0.14	9.18	8.00	0.0
3203	235	115	27.48	8.03	18.20	0.52	15.54	5.00	0.0
3204	242	127	54.27	35.99	24.09	0.52	16.11	10.00	0.0
3205	237	130	24.44	5.02	18.20	0.36	8.13	5.00	0.0
3206	237	137	53.89	10.70	12.15	0.25	17.97	13.00	0.10
3207	247	141	35.84	8.50	21.15	0.52	12.83	7.00	0.0
3208	243	141	41.10	7.93	18.18	0.32	14.78	7.00	0.0
3209	254	141	60.38	10.33	24.30	0.49	20.96	11.00	0.10
3210	238	167	29.19	4.50	12.15	0.25	6.51	11.00	0.0
3211	243	170	40.02	9.02	19.63	0.36	14.88	12.00	0.0
3212	250	166	59.97	12.02	18.20	0.36	20.10	13.00	0.0
3213	260	138	42.62	6.95	18.18	0.32	13.83	12.00	0.0
3214	262	170	68.14	14.04	19.63	0.52	21.62	9.00	0.0
3215	246	176	62.44	12.02	21.15	0.52	13.68	9.00	0.0
3216	244	182	61.87	11.55	18.20	0.52	18.87	8.00	0.10
3217	254	153	30.52	5.20	9.77	0.25	8.27	6.00	0.0
3218	249	154	40.40	8.20	14.63	0.25	13.66	6.00	0.10
3219	245	153	35.46	8.80	9.77	0.25	10.04	8.00	0.0
3220	243	161	44.39	9.53	15.26	0.36	15.16	7.00	0.0
3221	228	182	21.21	3.90	12.15	0.25	6.12	5.00	0.0
3222	230	180	34.13	7.00	9.77	0.25	14.35	6.00	0.10
3223	234	173	43.82	8.50	15.26	0.36	13.17	5.00	0.10
3224	240	165	30.17	6.48	18.18	0.32	13.36	4.00	0.0
3225	237	162	47.43	7.60	9.77	0.25	14.05	10.00	0.0
3226	240	151	44.04	7.93	18.18	0.32	13.36	4.00	0.10
3227	192	7	40.59	10.52	13.74	0.36	13.83	12.00	0.10
3228	200	19	44.39	16.53	15.26	0.36	17.16	9.00	0.0
3229	190	19	46.86	11.55	13.74	0.36	18.87	9.00	0.0
3231	197	28	59.97	10.00	12.31	0.52	16.11	6.00	0.0
3232	199	27	56.36	15.45	17.09	0.49	21.14	5.00	0.10
3233	196	29	50.85	10.04	13.85	0.20	13.10	10.00	0.10
3234	193	26	66.81	12.51	12.53	0.30	16.49	9.00	0.0
3235	193	25	67.33	10.70	12.15	0.25	17.29	7.00	0.0
3236	181	30	65.67	9.02	12.31	3.20	26.94	8.00	0.10
3237	179	22	61.87	9.53	15.26	0.36	14.38	7.00	0.0
3238	180	25	69.28	12.51	12.53	0.99	17.01	8.00	0.0
3239	177	23	66.24	12.51	11.21	0.50	16.49	9.00	0.0
3240	186	25	74.03	12.51	11.21	0.30	17.43	8.00	0.0
3241	203	45	59.02	27.00	13.85	0.40	26.97	12.00	0.0
3242	195	38	62.06	23.45	13.85	0.40	21.42	12.00	0.0
3243	193	56	50.66	21.90	12.15	0.50	23.75	11.00	0.10
3244	205	52	47.24	28.17	12.53	0.30	23.44	12.00	0.0
3245	210	53	45.53	27.77	21.15	0.36	23.14	11.00	0.10
3246	204	72	52.37	12.02	15.58	0.36	15.16	2.00	0.0
3247	212	72	66.05	13.10	12.15	0.25	21.21	8.00	0.0
3248	184	56	53.89	10.00	12.15	0.50	17.29	7.00	0.10

NUMBER	COORDINATE		ZN	NI	PB	AG	CU	TAMS	CXCU
	X	Y							
3249	185	57	58.26	8.80	12.15	0.50	16.21	10.00	0.10
3251	183	39	57.88	12.51	13.85	0.50	18.93	12.00	0.10
3252	189	39	64.15	9.40	12.15	0.50	14.35	13.00	0.10
3253	189	40	63.39	7.60	12.15	0.25	10.82	12.00	0.0
3254	213	105	52.97	6.01	22.28	0.14	10.60	12.00	0.0
3255	224	78	38.15	7.93	18.18	0.32	13.36	0.50	0.0
3256	205	90	34.16	4.50	20.25	0.14	11.08	0.50	0.0
3257	213	96	26.15	5.20	12.15	0.25	9.35	0.0	0.0
3258	219	90	34.13	6.40	14.63	0.25	10.04	0.50	0.10
3259	210	88	27.86	4.50	12.15	0.25	8.27	0.50	0.0
3260	211	82	37.93	6.40	12.15	0.25	10.82	0.50	0.0
3261	212	83	37.93	7.00	12.15	0.25	11.90	0.50	0.0
3262	133	60	46.10	42.00	17.10	0.50	26.70	0.50	0.0
3263	131	43	51.80	10.70	14.63	0.50	16.50	4.00	0.0
3264	126	40	62.85	7.46	20.25	0.32	13.36	0.50	0.0
3265	126	36	26.72	4.50	14.63	0.25	7.88	2.00	0.0
3266	130	33	42.14	6.01	18.18	0.14	12.41	0.50	0.0
3267	118	44	55.79	12.50	17.10	0.50	22.38	1.00	0.10
3268	115	51	37.93	15.60	17.10	0.50	17.97	2.00	0.10
3269	119	56	50.93	27.77	24.30	0.32	22.36	2.00	0.10
3270	100	29	57.91	11.32	22.28	0.14	22.38	2.00	0.0
3272	121	19	51.23	10.00	14.63	0.50	16.21	2.00	0.10
3273	117	17	66.84	11.32	20.25	0.32	20.48	1.00	0.0
3274	122	10	47.08	8.87	16.11	0.14	15.26	1.00	0.10
3275	143	71	27.86	3.90	9.77	0.25	7.19	0.0	0.0
3276	143	72	78.62	7.93	16.11	0.32	14.78	3.00	0.10
3277	149	78	61.90	7.46	18.18	0.14	16.68	2.00	0.0
3278	142	85	82.96	8.20	14.63	0.50	15.43	5.00	0.0
3279	144	92	69.22	6.95	18.18	0.14	12.88	1.00	0.0
3280	143	106	88.66	9.53	15.26	0.52	14.59	1.00	0.10
3281	143	104	68.27	8.40	20.25	0.14	16.68	2.00	0.10
3282	153	96	77.26	13.53	16.68	0.52	21.91	1.00	0.0
3283	154	86	64.85	6.48	20.25	0.14	16.21	4.00	0.10
3284	152	85	54.97	6.48	2.03	0.32	19.53	2.00	0.0
3285	160	78	82.99	9.39	18.18	0.32	17.63	1.00	0.10
3286	160	80	83.47	6.48	24.30	0.32	14.78	2.00	0.0
3287	151	71	76.69	12.02	16.58	0.52	19.63	1.00	0.10
3288	151	72	68.71	8.20	14.63	0.25	14.35	1.00	0.10
3289	148	66	47.56	5.54	16.11	0.32	11.08	3.00	0.10
3290	189	91	65.10	8.78	13.85	0.30	13.10	0.50	0.10
3291	193	86	65.67	10.04	11.21	0.30	12.59	0.50	0.0
3292	199	86	38.12	10.04	11.21	0.20	14.04	0.0	0.0
3293	198	85	46.10	13.73	13.85	0.20	15.03	0.50	0.0
3294	193	82	53.13	14.94	13.85	0.20	19.45	0.0	0.0
3295	193	81	57.88	14.94	13.85	0.30	16.49	1.00	0.0
3296	191	79	36.98	13.73	13.85	0.20	16.49	0.0	0.0
3297	188	76	38.12	11.25	11.21	0.20	14.04	0.50	0.10
3298	195	75	47.24	14.94	13.85	0.20	18.46	0.0	0.0
3299	191	75	62.63	17.37	15.23	0.30	24.43	1.00	0.0
3300	186	64	44.80	14.07	12.46	0.37	17.56	0.50	0.0
3301	173	62	48.38	10.04	13.85	0.20	15.50	0.50	0.10

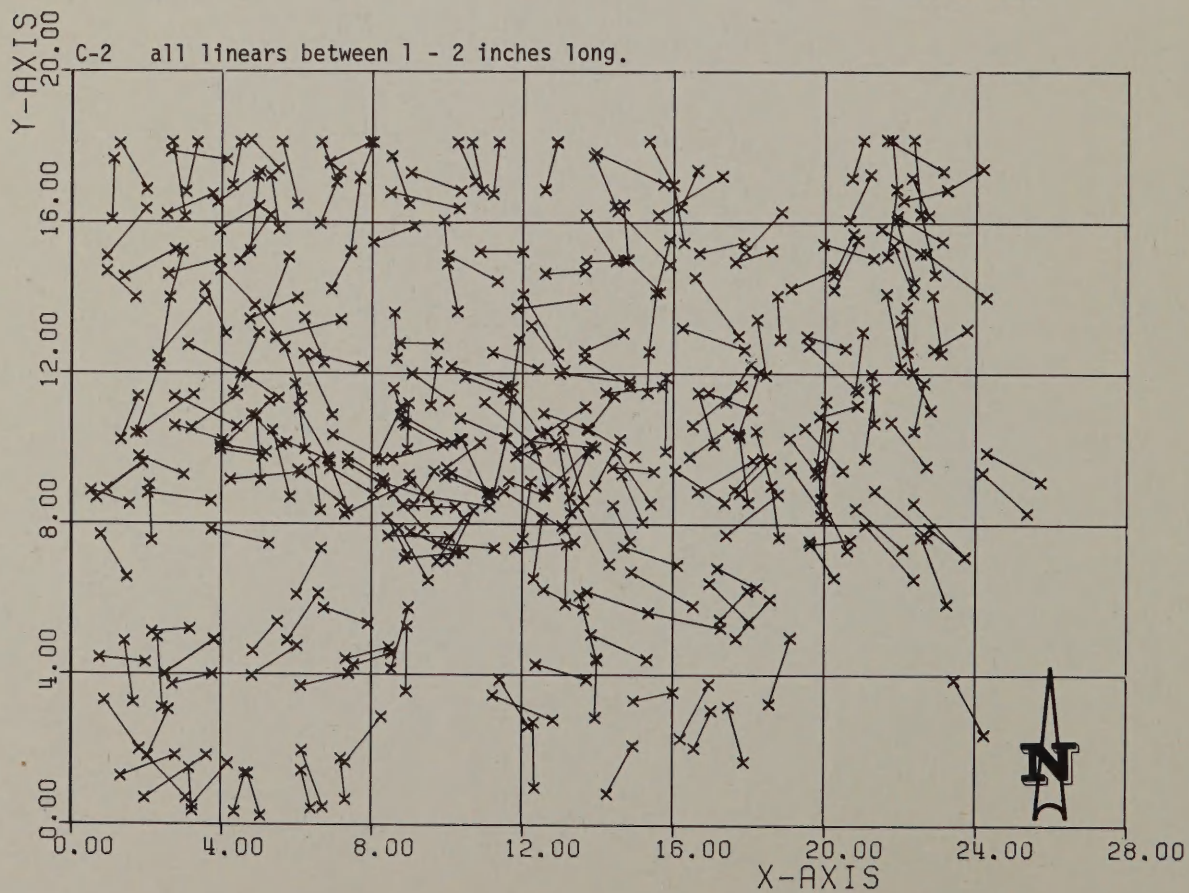
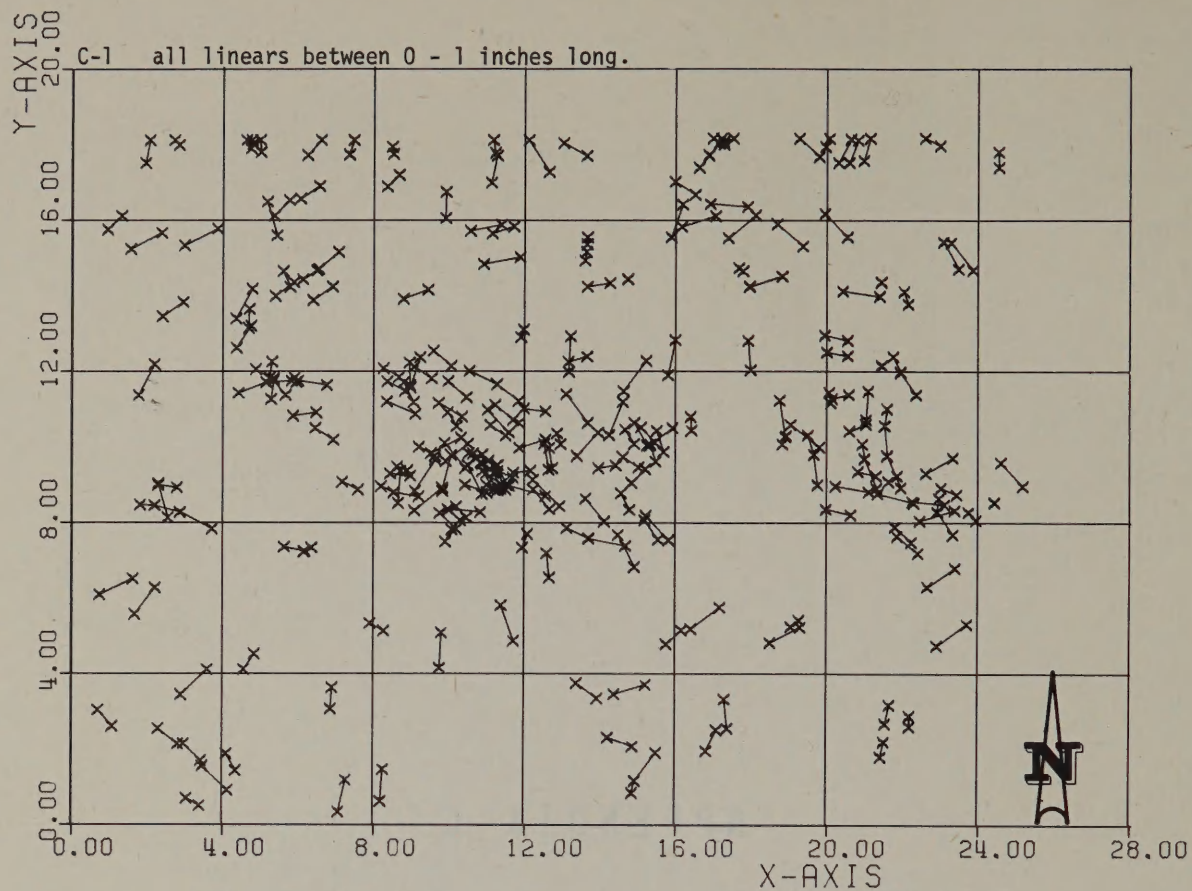
NUMBER	COORDINATE		ZN	NI	PR	AG	CU	THMS	CXCU
	X	Y							
3302	157	67	38.69	10.04	13.85	0.30	12.59	0.0	0.0
3303	152	59	40.97	6.26	9.97	0.11	9.72	0.0	0.0
3304	155	54	65.10	23.45	15.23	0.40	27.96	0.50	0.0
3305	153	55	70.42	14.94	13.85	0.30	22.93	2.00	0.0
3306	138	56	45.53	17.37	13.85	0.20	16.02	0.0	0.0
3307	142	40	82.77	19.80	13.85	0.40	24.95	3.00	0.0
3308	146	37	77.83	16.16	12.53	0.30	19.97	2.00	0.10
3309	147	36	69.85	18.59	13.85	0.30	22.93	2.00	0.0
3310	227	44	47.81	31.73	19.58	0.30	24.43	0.50	0.0
3311	179	72	47.81	10.04	13.85	0.20	14.04	1.00	0.10
3401	191	177	25.77	7.52	7.51	0.20	12.12	1.00	0.0
3402	193	173	43.82	10.00	13.74	0.36	17.63	0.0	0.0
3403	192	172	33.37	8.50	13.74	0.36	15.64	0.0	0.0
3404	193	169	64.34	14.94	13.85	0.40	22.46	1.00	0.0
3405	195	165	43.06	9.02	15.26	0.36	13.83	0.0	0.0
3406	200	161	51.42	14.94	11.21	0.30	17.99	1.00	0.0
3407	196	158	60.92	12.51	12.53	0.20	14.56	0.0	0.0
3408	194	156	53.70	11.25	12.53	0.20	11.13	0.0	0.0
3409	194	141	60.92	14.94	13.85	0.30	16.02	0.0	0.0
3410	194	150	63.20	16.16	15.23	0.40	21.94	1.00	0.10
3411	180	174	60.16	14.94	15.23	0.30	20.44	0.50	0.10
3412	175	167	46.86	9.53	15.26	0.36	15.64	0.0	0.0
3413	178	175	52.02	6.48	16.11	0.32	12.41	2.00	0.0
3414	169	179	63.77	13.73	16.63	0.30	18.93	2.00	0.0
3415	167	180	59.59	17.37	15.23	0.40	25.94	1.00	0.0
3416	163	176	85.81	16.16	15.23	0.40	21.94	0.0	0.0
3417	164	181	70.42	19.80	13.85	0.40	22.46	0.50	0.0
3418	182	167	42.68	11.25	13.85	0.20	14.56	0.0	0.0
3419	189	163	42.11	11.25	8.72	0.20	12.12	0.0	0.0
3420	188	162	38.12	7.52	11.21	0.20	11.65	0.0	0.0
3421	178	161	65.10	13.73	13.85	0.30	16.02	1.00	0.0
3422	184	153	70.42	16.16	12.53	0.61	21.94	1.00	0.0
3423	182	145	43.25	8.78	12.53	0.20	12.59	0.0	0.0
3424	137	145	30.14	11.25	11.21	0.20	14.56	0.0	0.0
3425	165	158	87.14	16.16	15.23	0.40	24.95	3.00	0.0
3426	170	152	96.07	11.04	21.15	0.67	20.85	1.00	0.0
3427	172	150	48.00	9.02	19.63	0.36	15.35	0.50	0.0
3428	172	144	42.11	11.25	11.21	0.30	16.49	0.50	0.10
3429	172	137	67.00	9.53	15.26	0.36	15.35	0.50	0.0
3430	169	130	80.30	14.94	13.85	0.40	22.93	2.00	0.0
3431	161	141	57.31	13.73	15.23	0.40	22.46	1.00	0.0
3432	158	150	76.50	16.77	16.63	0.50	32.56	0.0	0.0
3433	160	130	78.40	8.36	15.23	0.40	18.98	1.00	0.0
3434	157	136	72.32	10.00	15.23	0.40	19.97	1.00	0.0
3435	152	181	41.92	7.51	16.68	0.21	14.12	0.0	0.0
3436	152	173	38.31	6.01	15.26	0.36	12.41	0.0	0.0
3437	158	169	41.35	7.51	16.68	0.36	14.59	0.50	0.0
3438	152	162	49.33	9.53	19.63	0.36	22.95	3.00	0.0
3439	162	165	62.63	12.54	15.23	0.40	24.43	3.00	0.0
3440	128	172	60.54	10.52	19.63	0.52	19.34	2.00	0.0
3441	125	168	46.86	8.50	16.63	0.36	17.92	2.00	0.10

N	NUMBER	COORDINATE		ZN	NI	PB	AG	CU	TMS	CXCU
		X	Y							
	3442	124	167	61.87	12.02	21.15	0.67	24.19	0.50	0.0
	3443	133	160	71.75	10.00	18.09	0.50	18.46	1.00	0.0
	3444	127	162	67.33	9.20	13.85	0.40	16.02	2.00	0.0
	3445	110	87	70.99	6.67	13.85	0.30	11.65	2.00	0.10
	3446	112	85	96.07	49.53	15.26	0.57	24.19	6.00	0.0
	3447	107	84	67.00	9.53	16.68	0.52	16.40	0.50	0.0
	3448	102	74	59.59	10.00	13.85	0.30	17.99	3.00	0.10
	3449	94	74	50.16	9.20	13.85	0.30	18.46	1.00	0.0
	3450	86	77	65.10	10.00	13.85	0.30	15.50	2.00	0.0
	3451	82	78	68.14	13.06	18.20	0.52	20.86	2.00	0.10
	3452	91	78	50.47	9.53	13.74	0.36	18.68	2.00	0.0
	3453	90	79	27.48	4.50	9.37	0.21	6.71	0.0	0.0
	3454	92	86	38.12	7.51	12.53	0.20	16.02	3.00	0.0
	3455	93	85	92.65	15.55	18.20	0.67	26.18	3.00	0.0
	3456	73	17	38.88	9.02	15.26	0.21	14.40	3.00	0.0
	3457	103	57	36.96	22.65	16.68	0.36	20.39	0.0	0.10
	3458	93	62	47.43	30.82	16.68	0.36	20.67	1.00	0.10
	3459	86	63	55.41	37.54	25.61	0.52	26.94	1.00	0.0
	3460	86	64	44.39	28.76	16.68	0.36	23.71	1.00	0.0
	3461	95	67	38.31	25.70	10.89	0.36	21.62	0.0	0.10
	3462	105	64	44.96	31.34	15.26	0.52	26.18	1.00	0.0
	3463	114	67	48.38	31.39	12.53	0.30	25.94	0.0	0.10
	3464	114	66	52.37	37.03	13.74	0.36	26.47	0.0	0.0
	3465	120	62	32.42	10.00	9.97	0.20	18.58	0.0	0.10

DUPLICATE SAMPLE ANALYSES

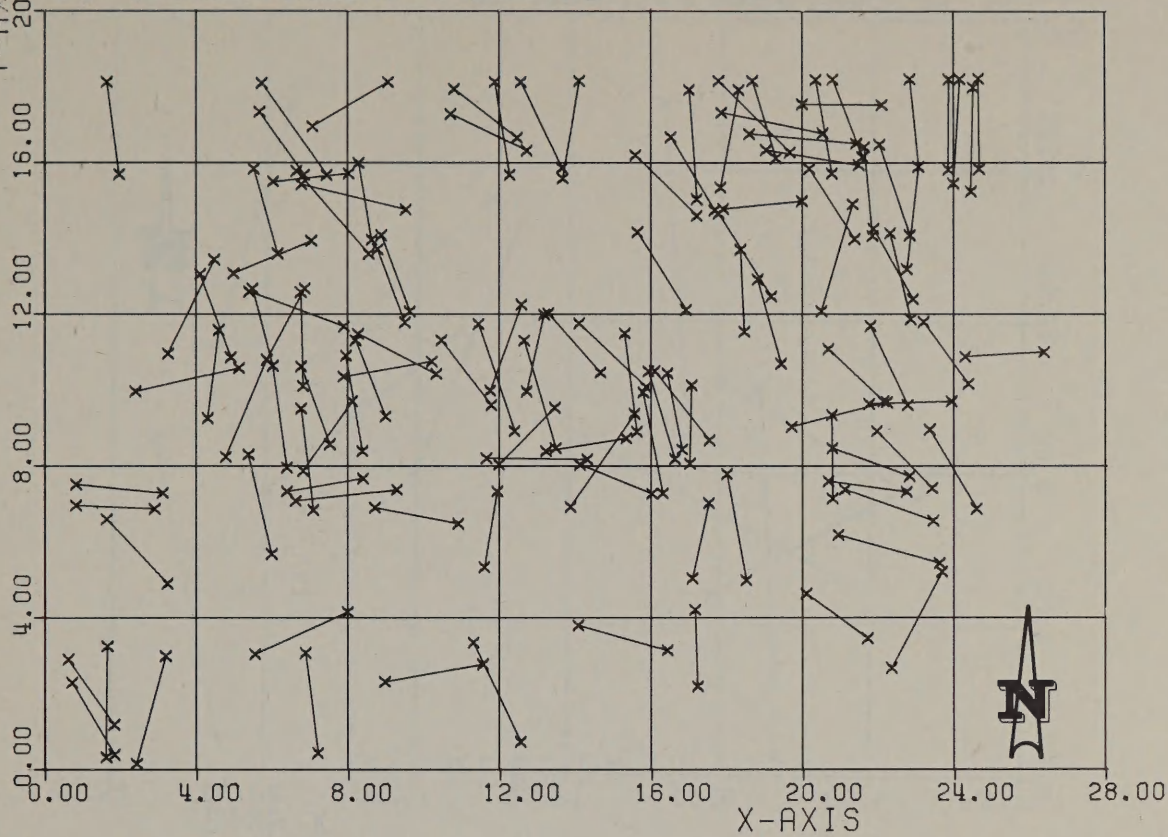
ZN	NI	PB	AG	CU	NUMBER
45.34	14.70	14.77	0.33	12.02	11030
56.60	11.34	15.04	0.50	15.16	11130
30.71	4.57	10.01	0.33	7.95	11250
52.70	10.66	12.50	0.30	15.16	11260
46.04	17.19	22.28	0.32	27.61	11550
41.10	5.07	20.25	0.14	8.23	11610
57.44	26.22	9.72	0.32	30.93	11730
48.76	7.55	5.02	0.33	13.28	21070
71.75	45.85	7.54	0.49	38.70	21090
75.65	12.56	17.53	0.30	25.33	21110
55.03	10.03	17.10	0.25	17.97	21210
100.40	61.81	7.52	0.50	42.01	21230
98.16	18.68	10.01	0.33	32.00	21370
78.35	34.61	12.50	0.50	36.62	21450
86.38	73.02	1.77	0.50	46.49	21570
55.03	40.53	1.00	0.25	25.23	21620
85.55	56.13	1.52	0.50	44.54	21760
46.10	10.52	18.20	0.36	16.59	21970
38.63	6.95	14.00	0.32	14.31	22010
68.90	40.65	16.68	0.52	34.16	22300
40.62	7.93	14.00	0.14	12.88	22320
76.63	10.85	24.30	0.14	20.48	22480
33.69	6.48	20.25	0.14	14.78	22510
58.45	9.20	13.85	0.30	14.56	22680
32.99	5.87	9.97	0.11	10.19	22820
58.64	11.55	22.67	0.36	18.68	22920
62.06	10.00	12.53	0.40	18.46	22980
57.88	11.69	12.53	0.30	19.45	23130
53.13	9.20	12.53	0.40	18.98	23320
33.56	5.87	5.97	0.20	8.73	23380
47.21	6.69	20.03	0.30	10.51	31100
39.83	22.50	7.38	0.25	18.66	31110
71.18	34.10	7.38	0.50	37.48	31220
98.16	10.51	19.36	0.49	20.65	31280
42.68	9.84	12.42	0.33	16.97	31290
82.70	6.01	15.04	0.30	8.04	31340
27.27	8.89	12.50	0.30	7.66	31560
62.00	32.74	15.04	0.50	30.46	31730
59.30	17.06	12.50	0.50	21.91	31810
63.20	16.68	12.42	0.49	34.52	31850
25.20	4.50	18.20	0.36	7.66	32050
43.06	8.03	15.26	0.36	12.88	32230
63.77	9.02	15.26	0.36	14.88	32370
62.63	23.45	12.53	0.30	21.42	32420
24.82	4.50	12.15	0.25	8.27	32570
52.50	8.87	18.18	0.32	15.73	32740
29.19	3.90	9.77	0.25	7.19	32750
50.28	14.94	13.85	0.20	18.98	32940
82.20	19.80	13.85	0.40	24.43	33070
49.14	13.73	15.23	0.30	18.98	34110
32.99	7.52	9.97	0.20	11.65	34200
68.90	11.04	16.68	0.36	15.64	34290
70.42	9.20	13.85	0.50	17.48	34440
97.40	14.04	16.68	0.52	24.95	34460
22.16	4.50	10.89	0.21	6.71	34530
68.27	8.40	20.25	0.14	16.68	32810

APPENDIX C



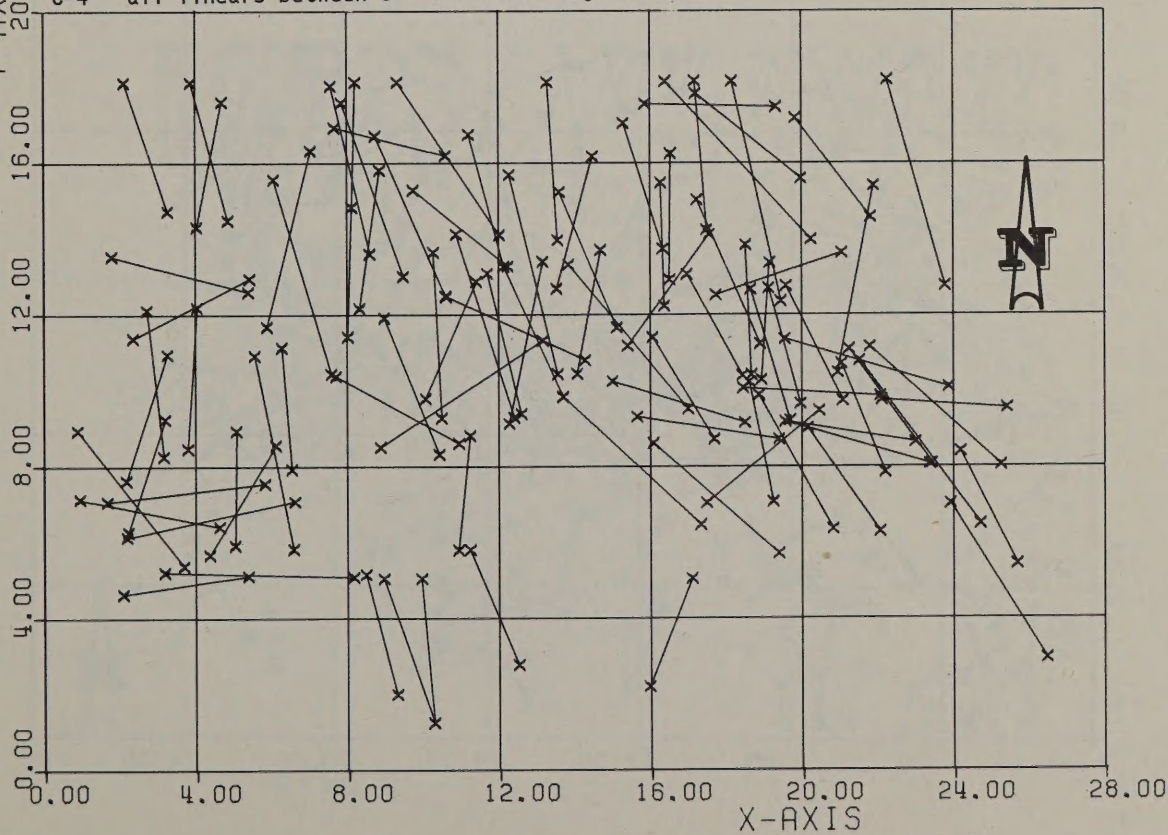
Y-AXIS

C-3 all linears between 2 - 3 inches long.

4 0 4
MILES

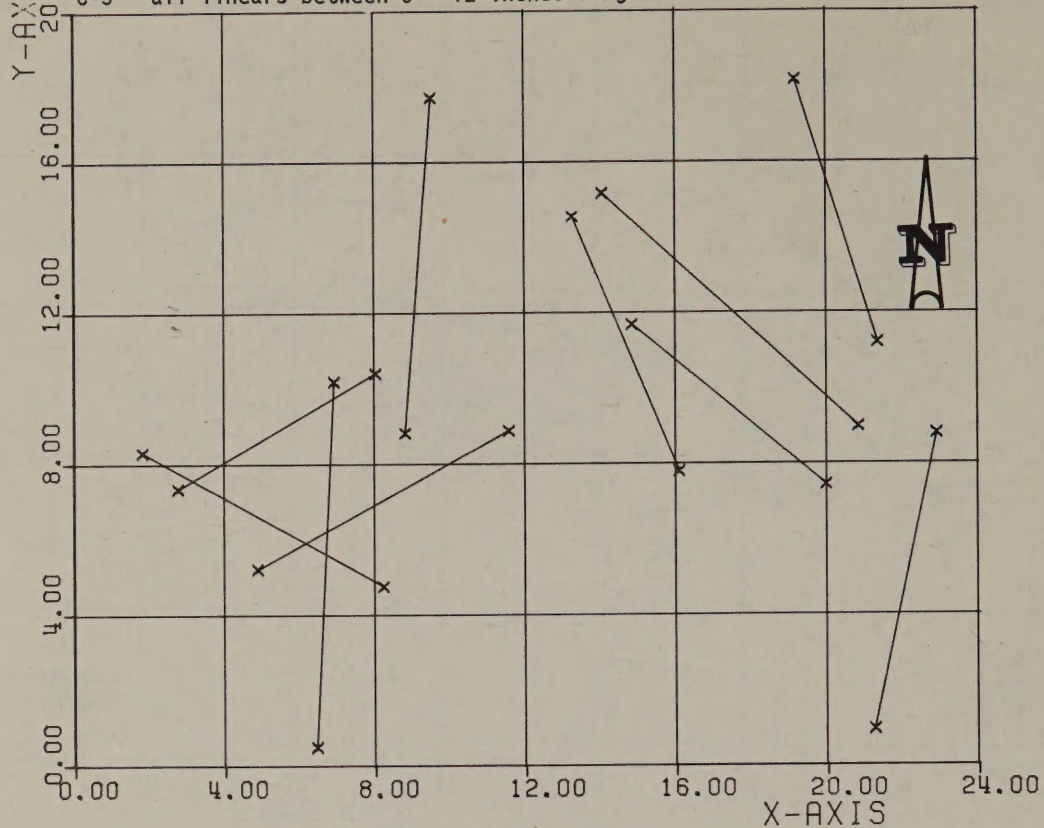
Y-AXIS

C-4 all linears between 3 - 6 inches long.

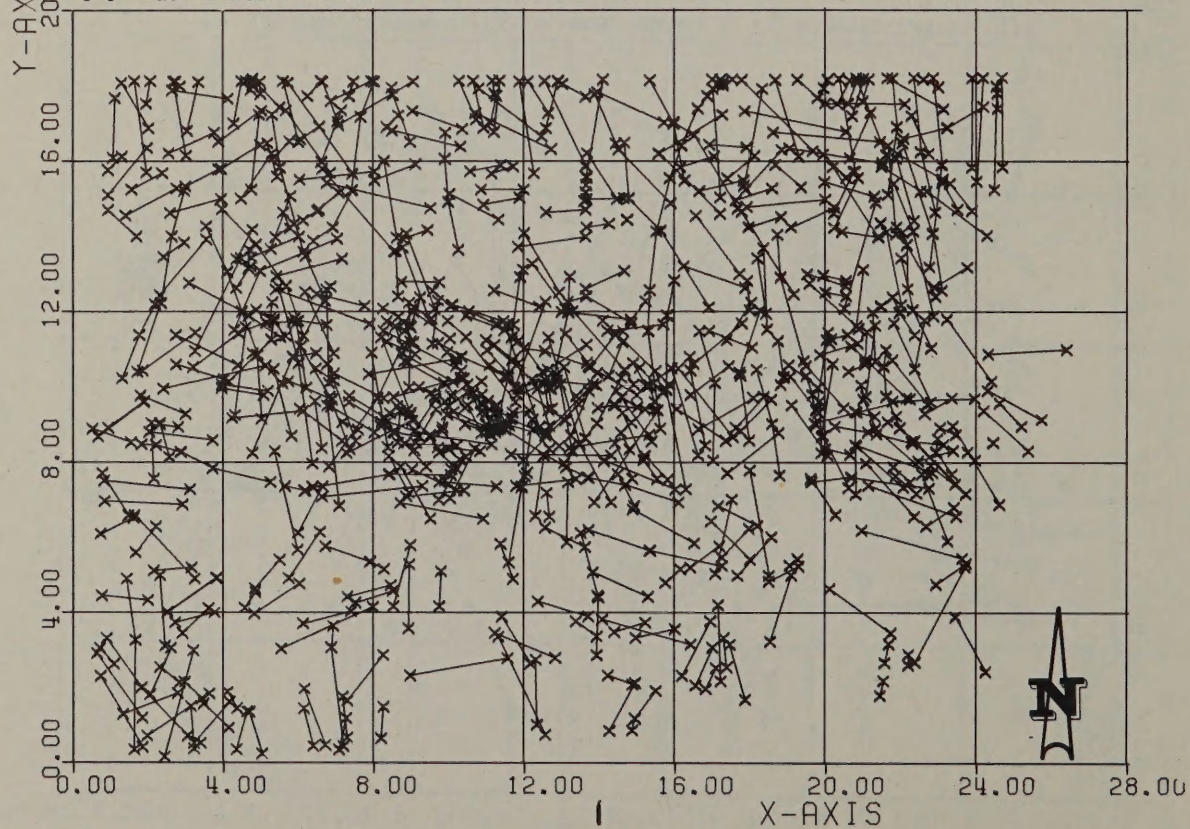


X-AXIS

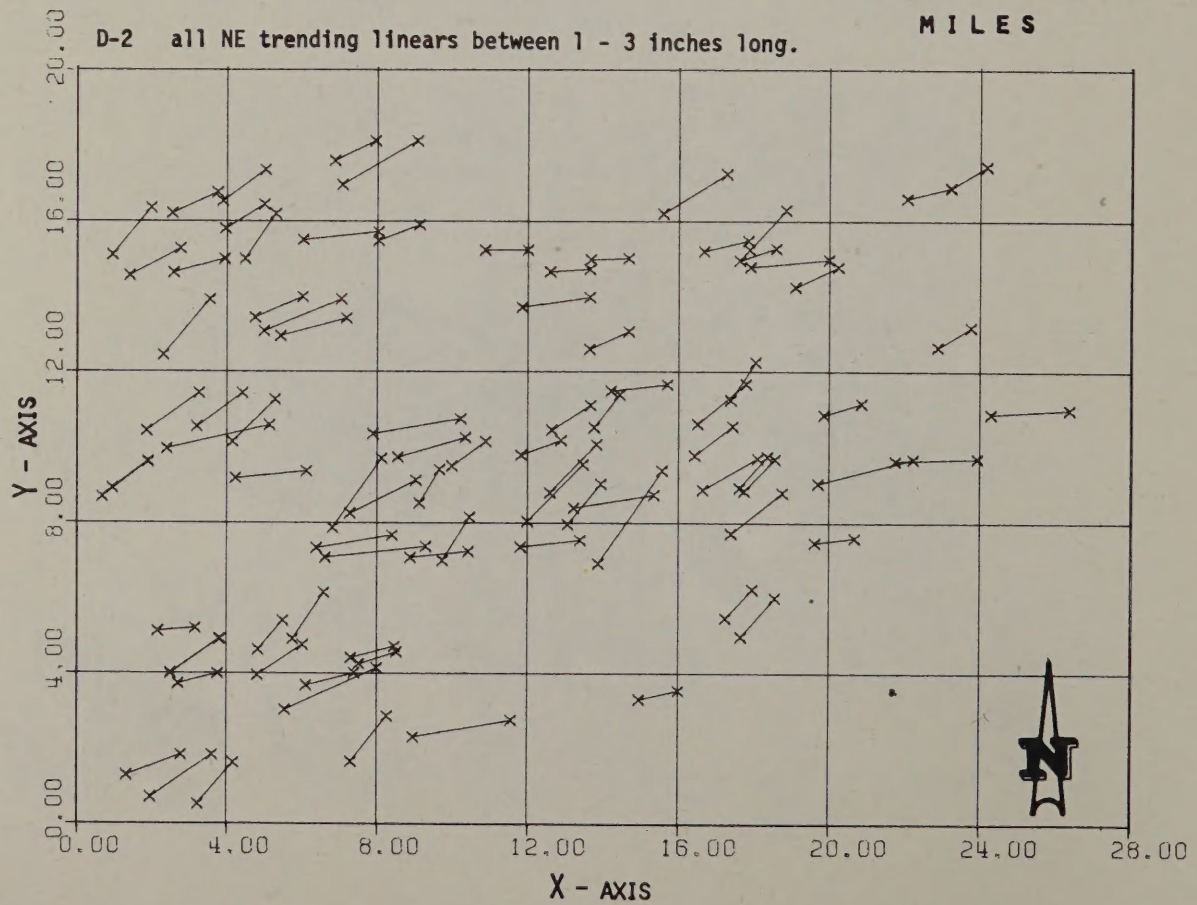
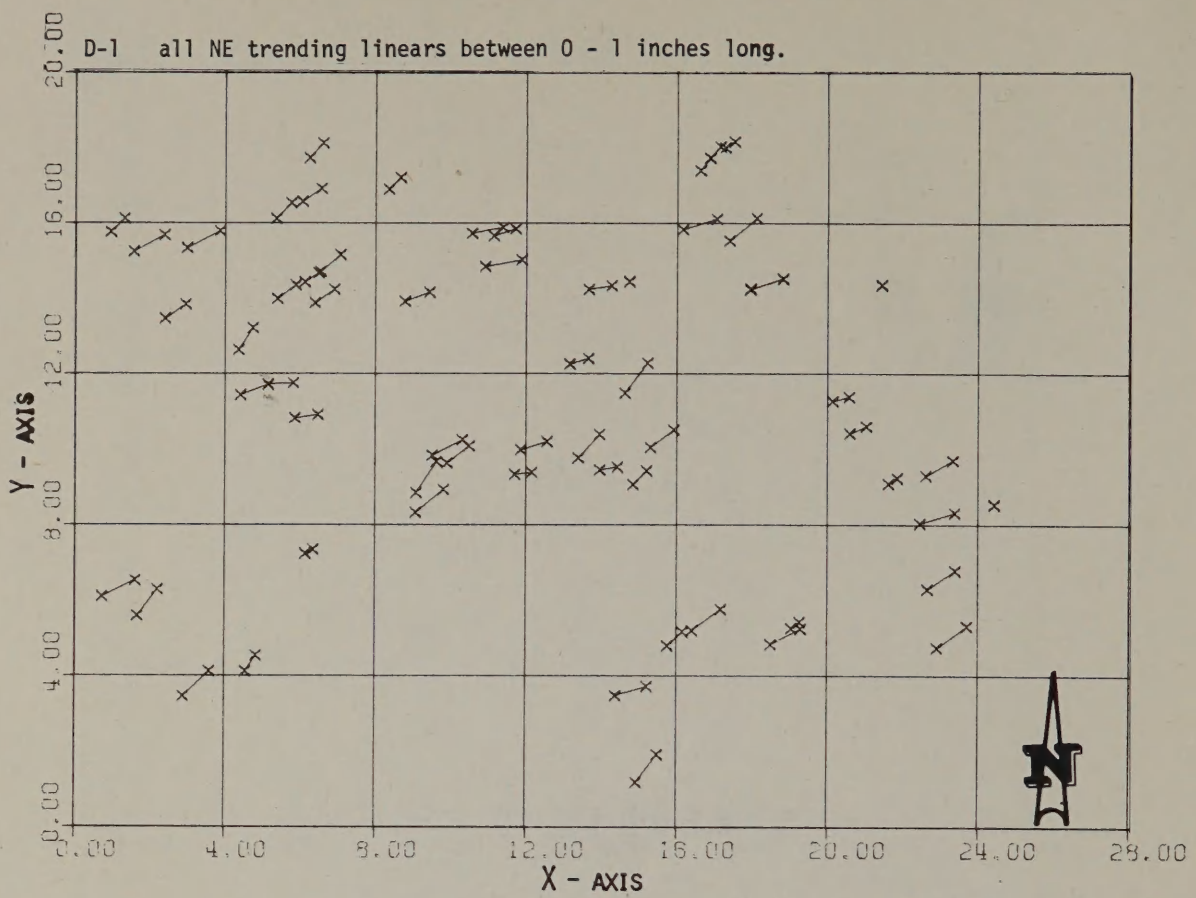
C-5 all linears between 6 - 12 inches long.

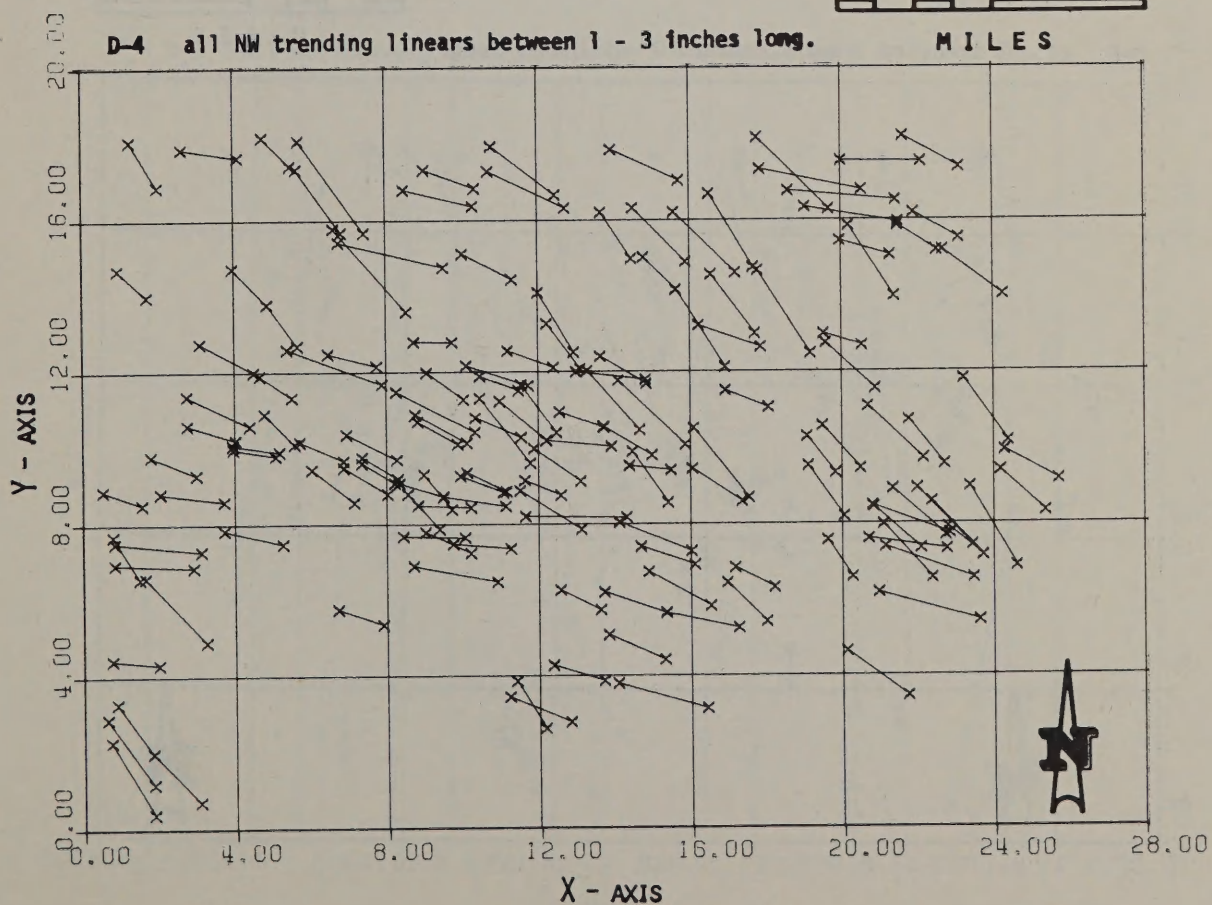
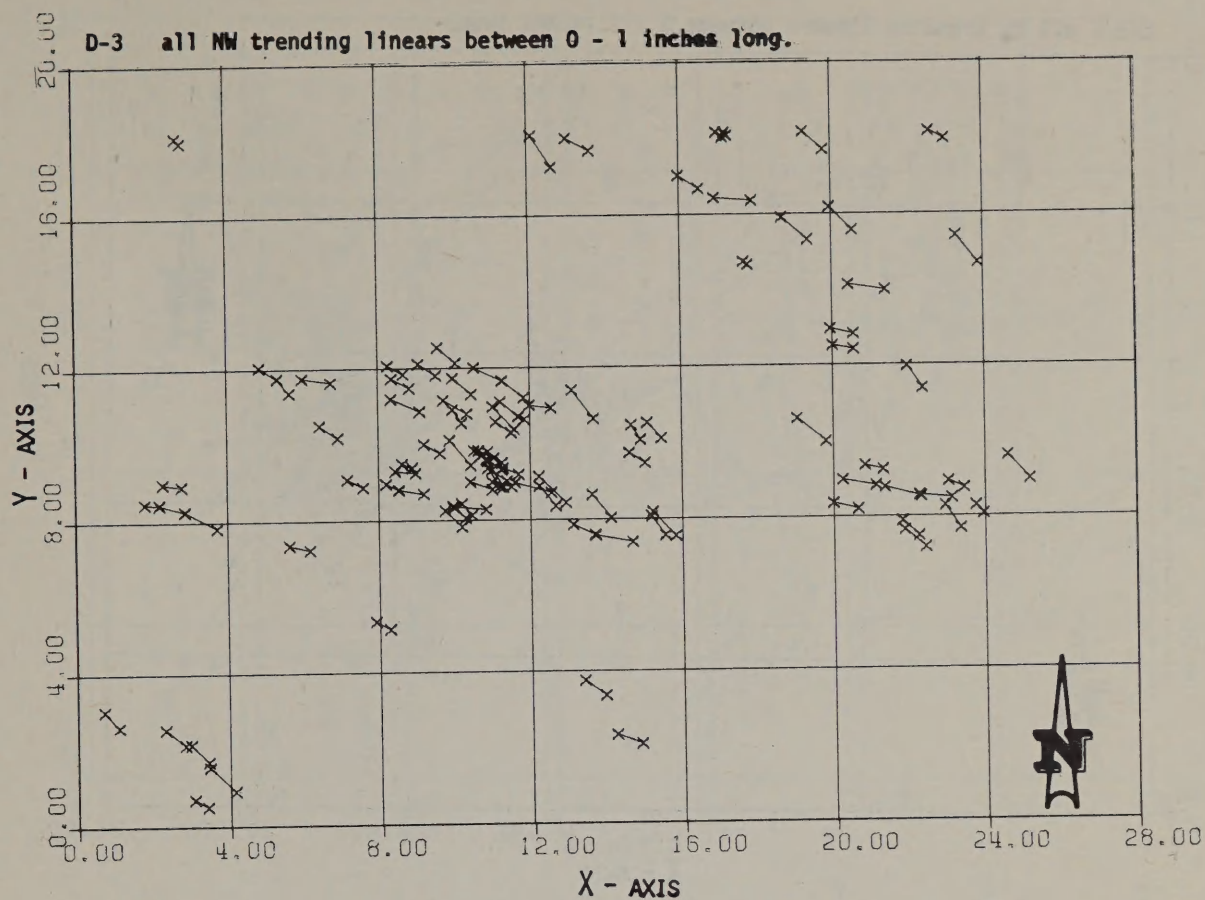


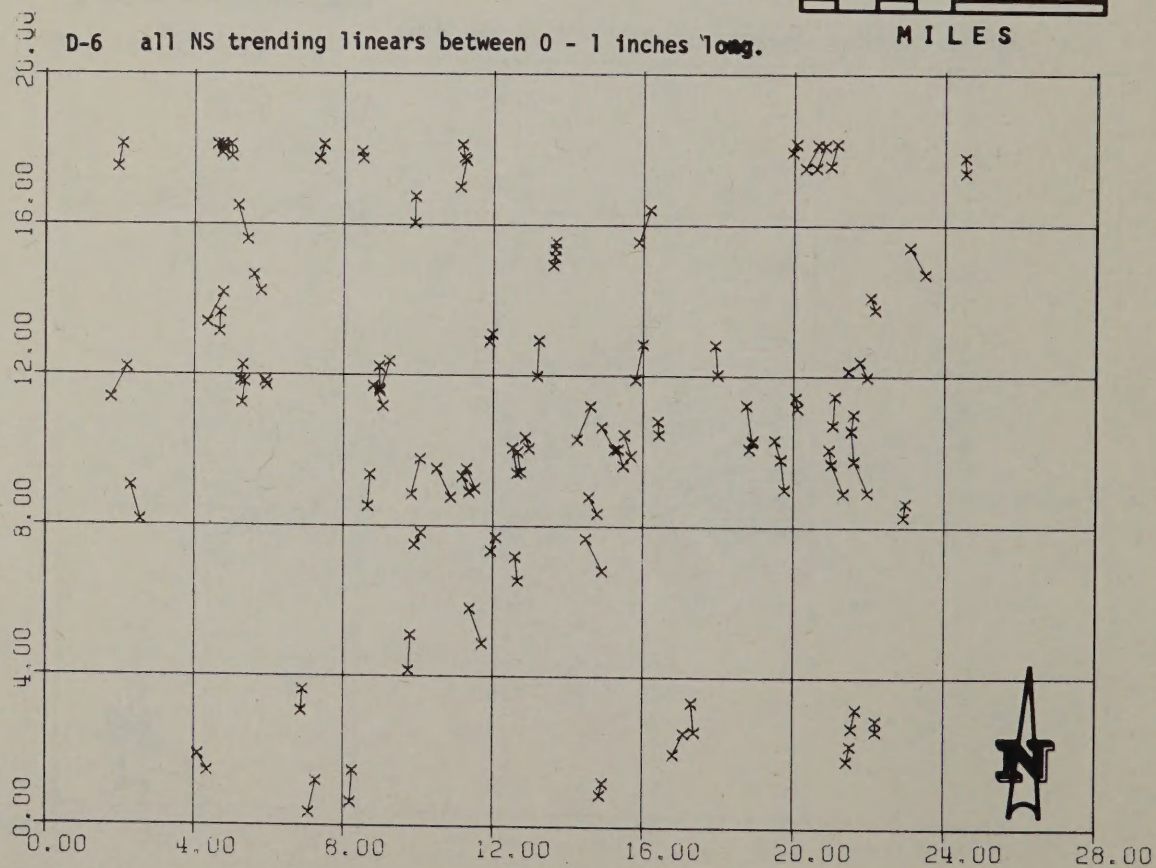
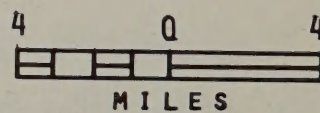
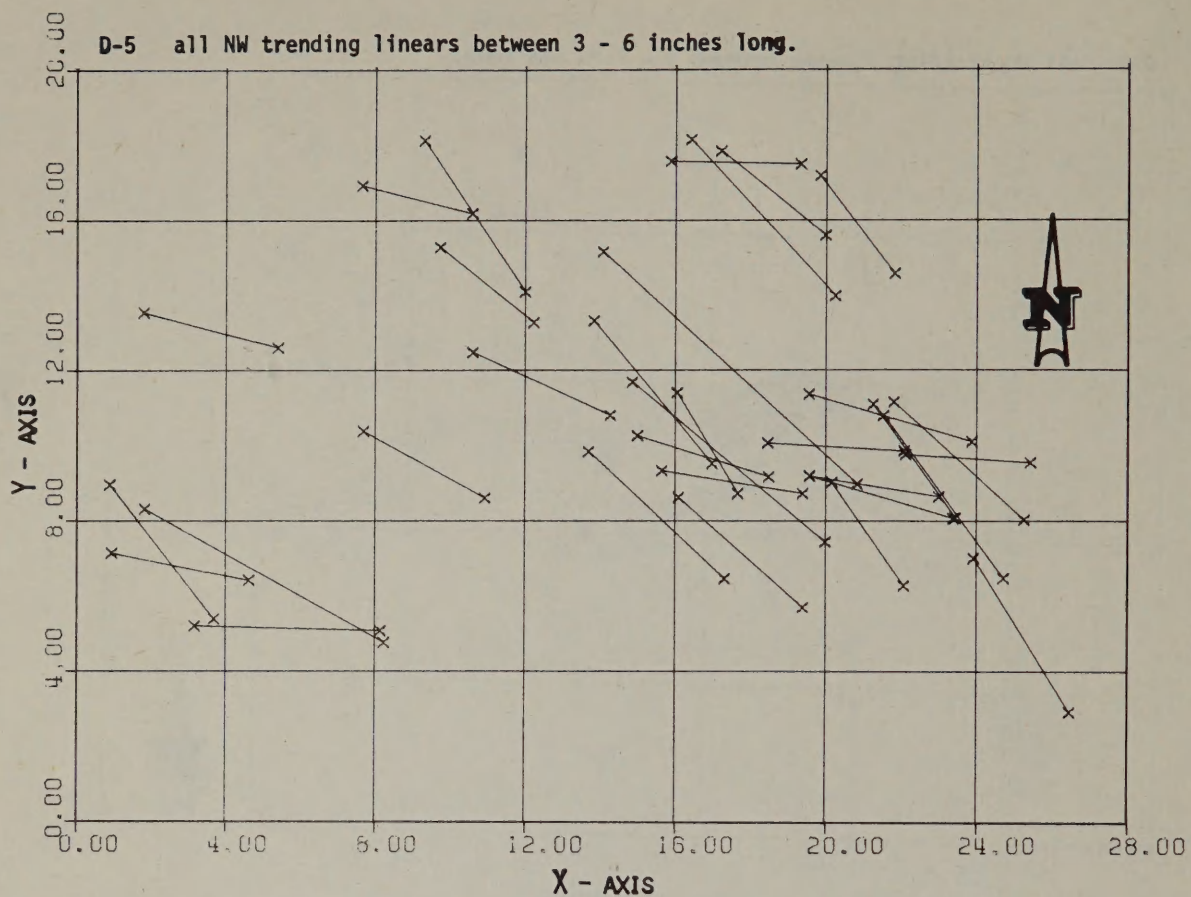
C-6 all linears between 0 - 12 inches long.



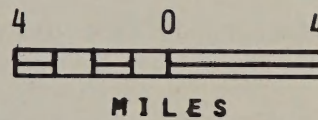
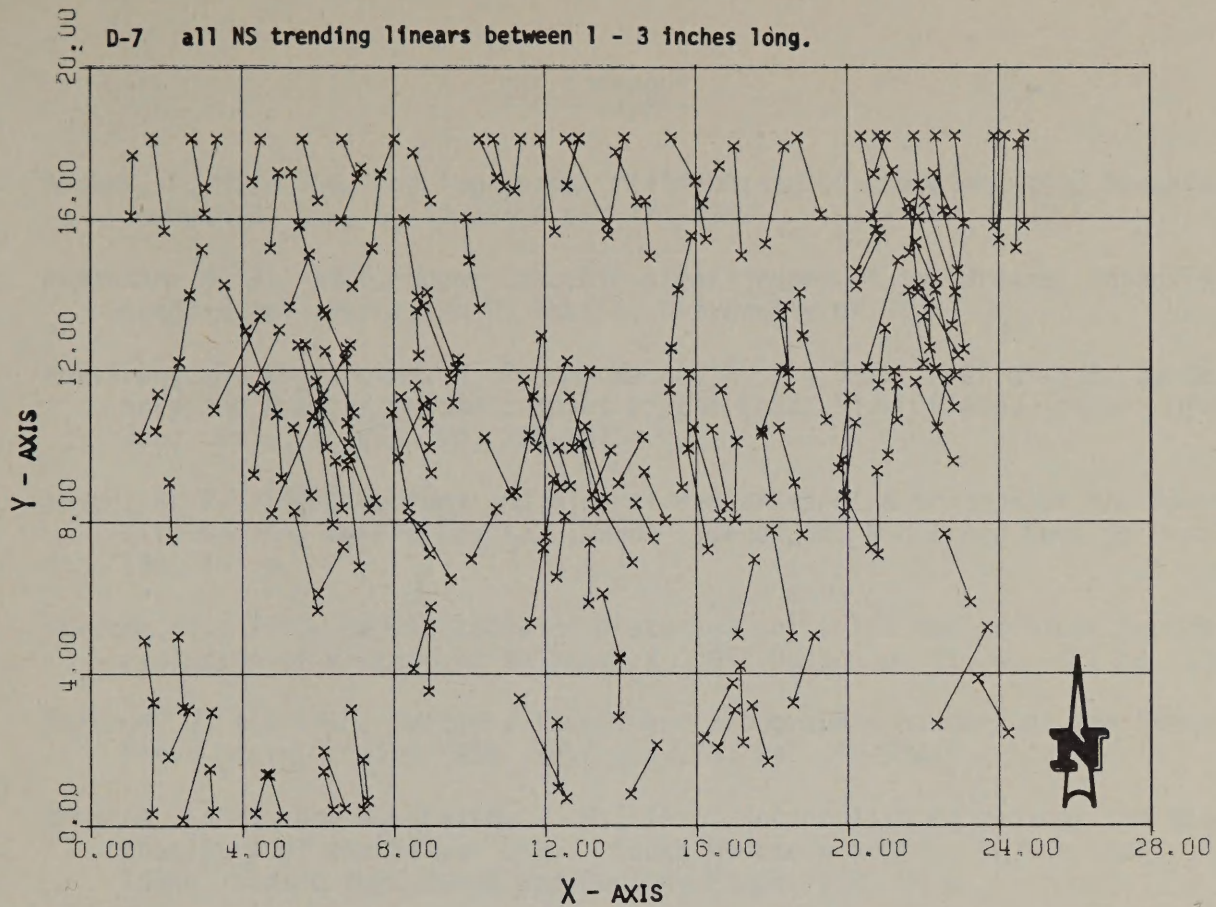
APPENDIX D



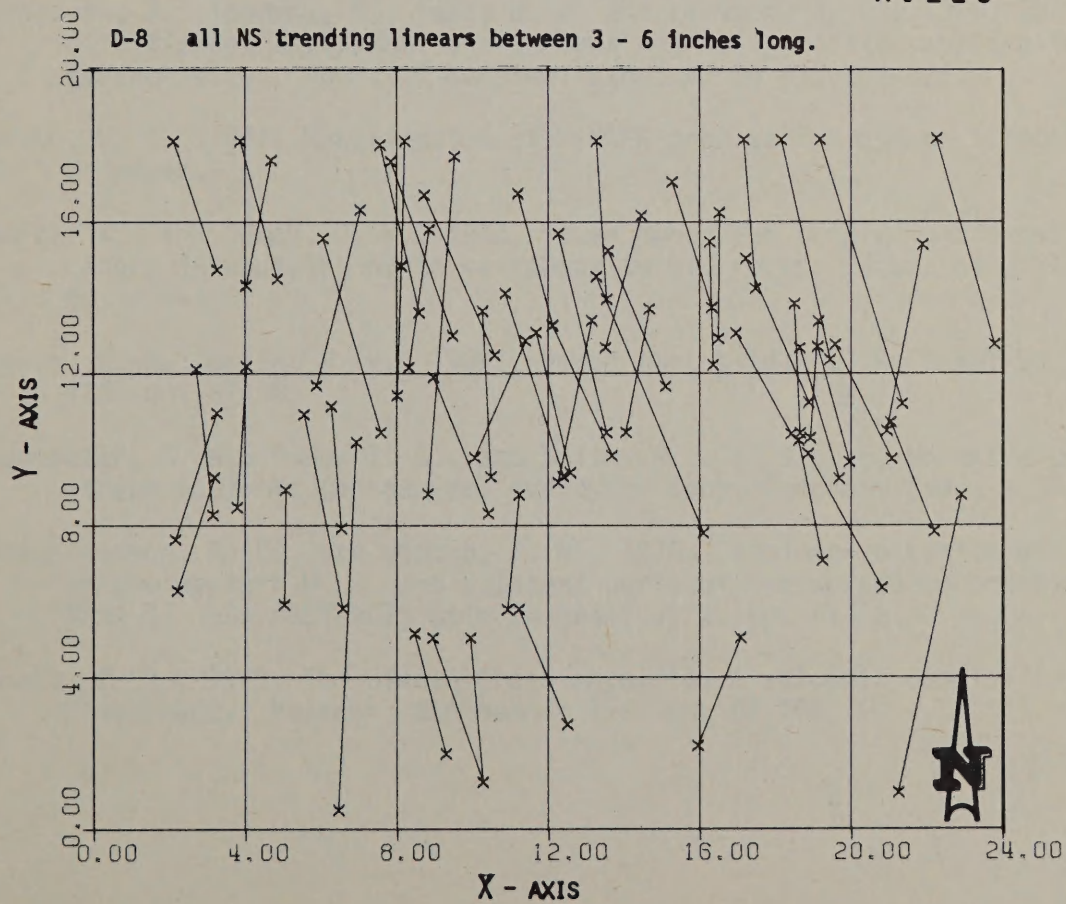




D-7 all NS trending linears between 1 - 3 inches long.



D-8 all NS trending linears between 3 - 6 inches long.



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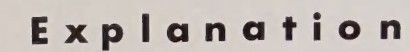
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CENOZOIC	Tertiary	Miocene	Quat.	Recent
			Qal	Alluvium
			Tbb	"Upper" Basalt equivalent
			Tj ¹	Juniper Mountain tuff and flow complex
			Tat	Antelope Ridge tuff
			Tt ₁ Tt _{1a}	Welded tuff 1 Tt ₁ and subunit(?) Tt _{1a}
			Tib	Interbeds in tuff units
			Tfd	Felsic domes
			Tlb	"Lower" Basalt
			Ktg	Grandiorite/Quartz monzonite
			Amp	Amphibolite? unit
			Meta	Metamorphic complex locally intermixed with Ktg

~~---~~
~~---~~
~~---~~
 Lithologic contacts, dashed where approximate,
 queried where uncertain or inferred

45
 Strike and dip of flow units in T1b ("Lower" Basalt)
 as estimated from airphotos

—
 Strike direction of joints in the welded tuff units

④
 Photograph reference number and view direction

1 0 1 2

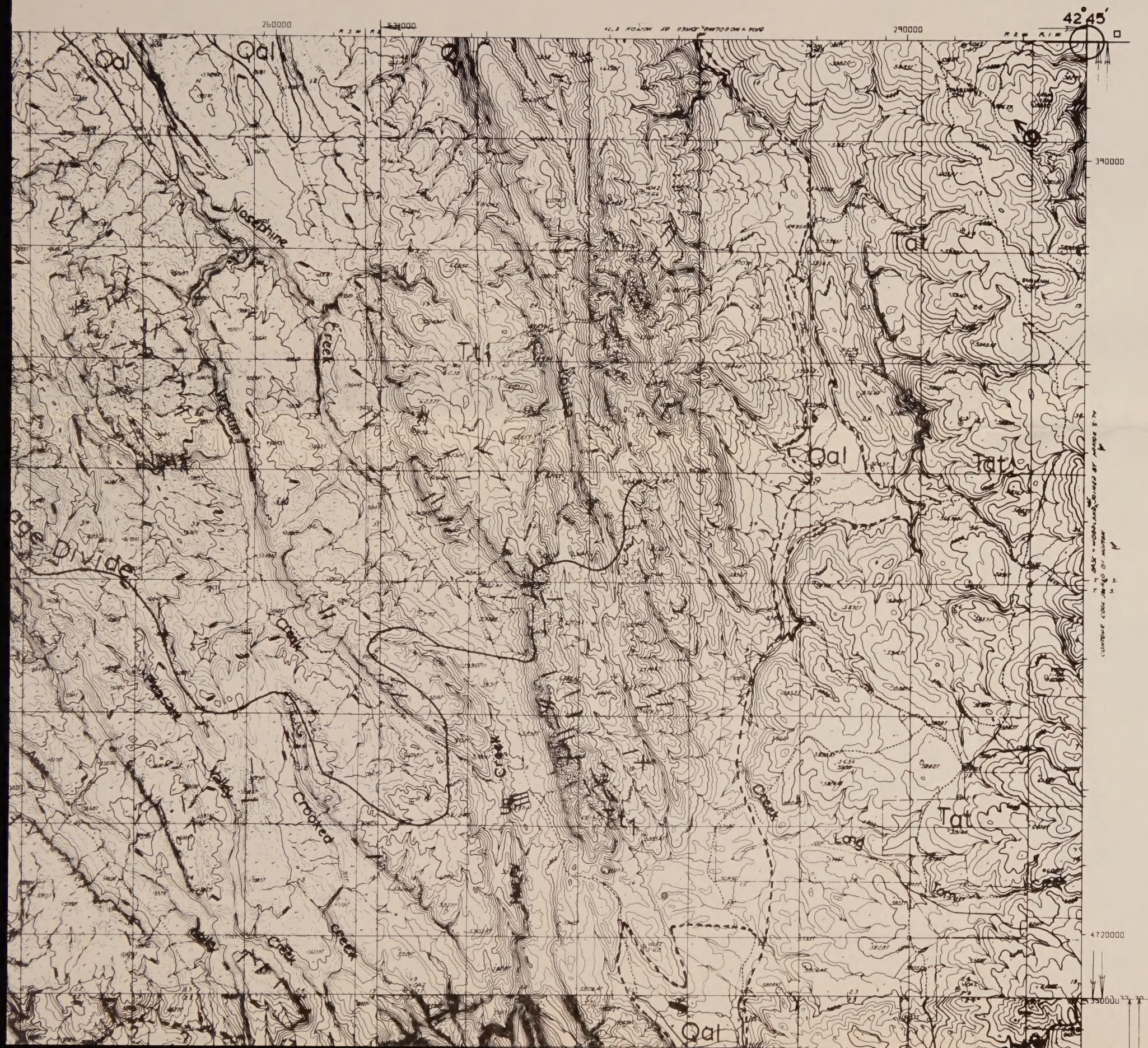
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SOUTH MOUNTAIN - JUNIPER MOUNTAIN REGION

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Explanation

CENOZOIC	Quat.		Recent		
	Tertiary				
	Miocene				
			Qal	Alluvium	
			Tbb	"Upper" Basalt equivalent	
					unconformity
			Tjt	Juniper Mountain tuff and flow complex	
			Tat	Antelope Ridge tuff	
			Tt ₁ Tt _{1a}	Welded tuff 1 Tt ₁ and subunit(?) Tt _{1a}	
			Tib	Interbeds in tuff units	
			Tfd	Felsic domes	
			Tlb	"Lower" Basalt	unconformity

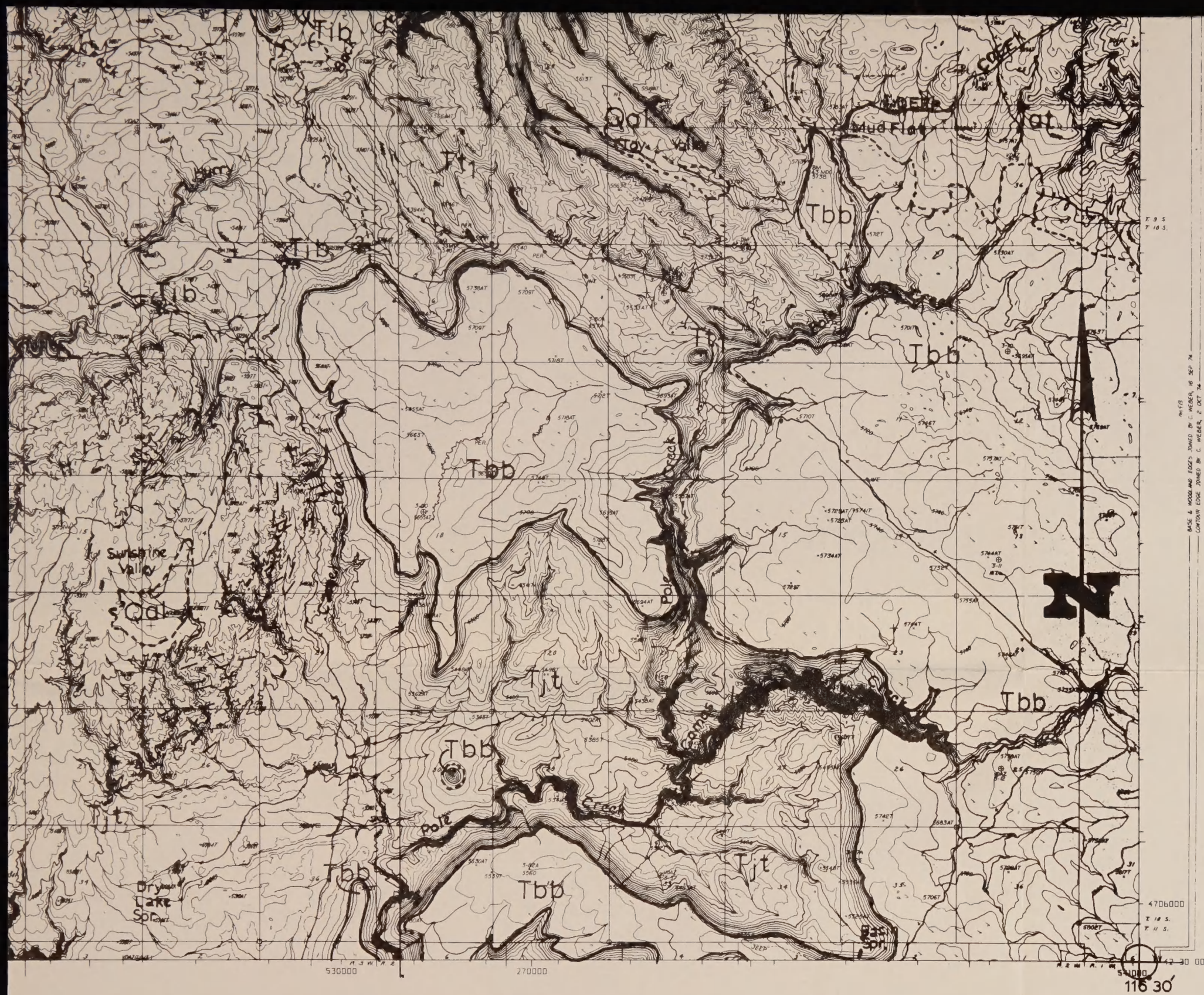


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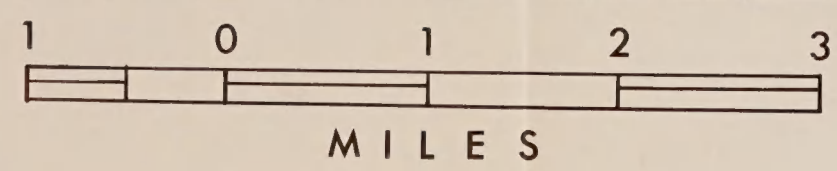
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MESO.	Cret.	PreCret.	Ktg	Grandiorite/Quartz monzonite
			Amp	Amphibolite? unit
			unconformity	
			Meta	Metamorphic complex locally intermixed with Ktg

- Lithologic contacts, dashed where approximate, queried where uncertain or inferred
- Strike and dip of flow units in Tlb ("Lower" Basalt) as estimated from airphotos
- Strike direction of joints in the welded tuff units
- Photograph reference number and view direction

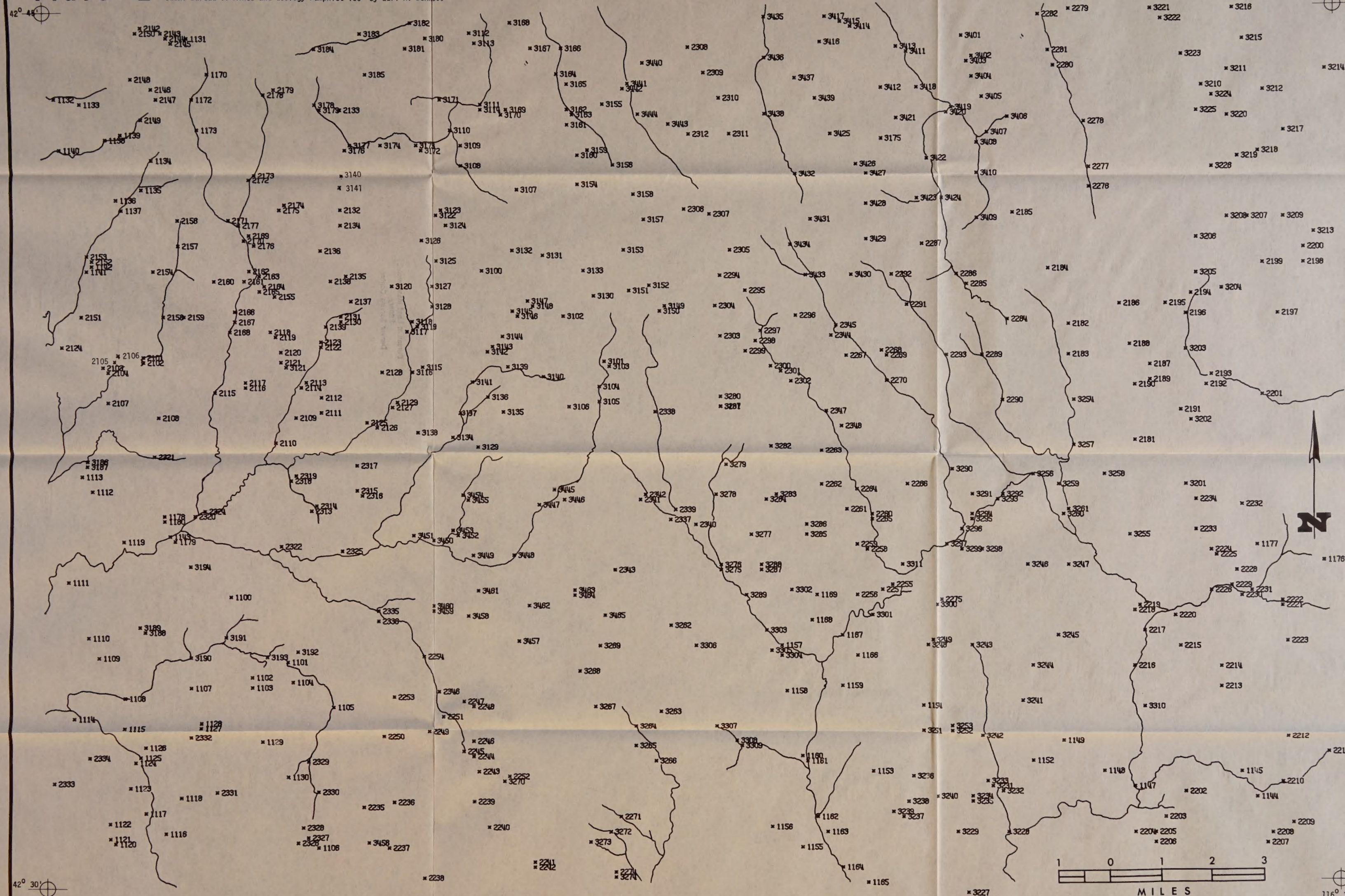
MAP



TAIN REGION

Plate 2

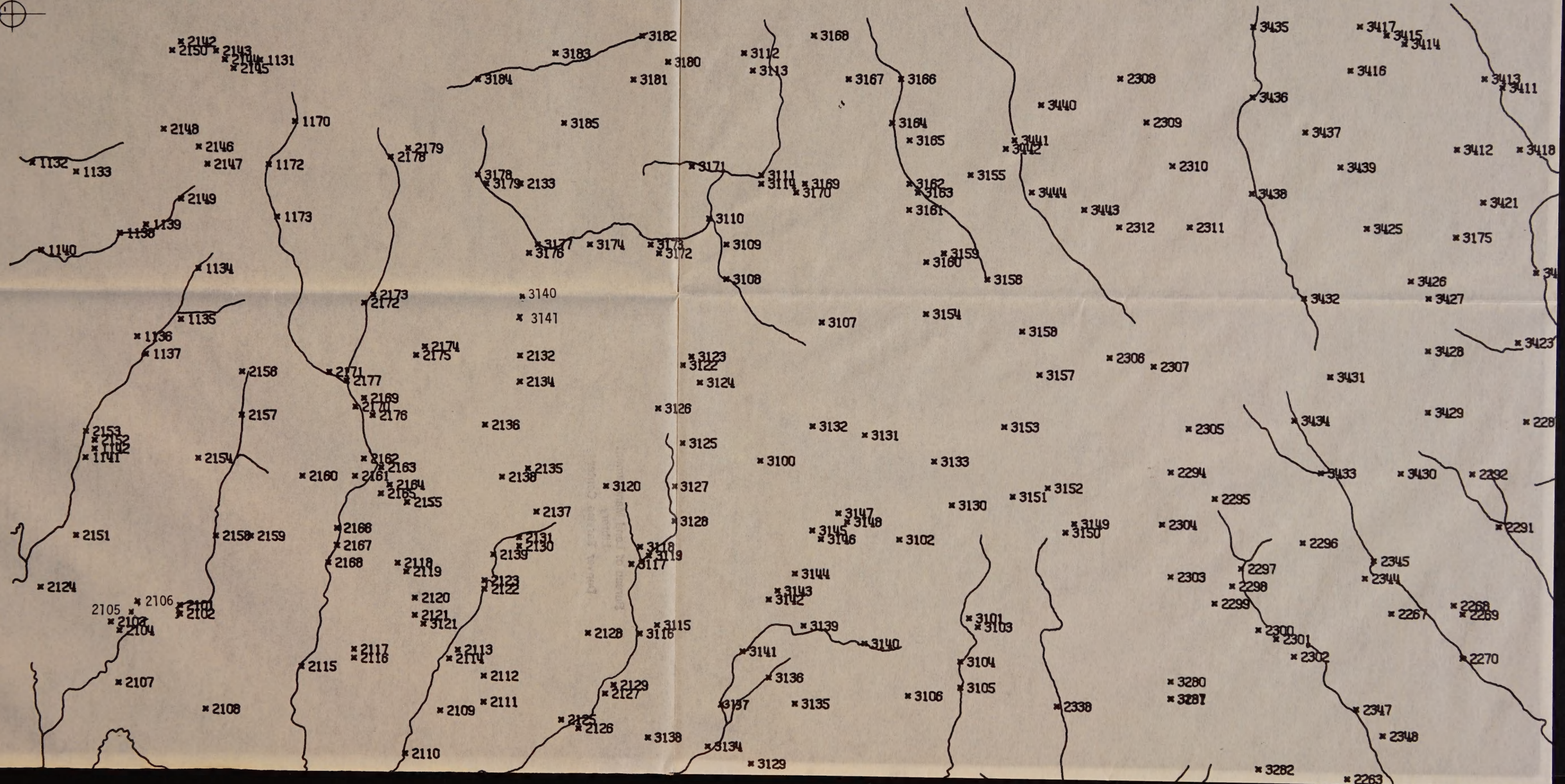
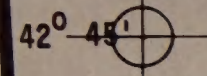
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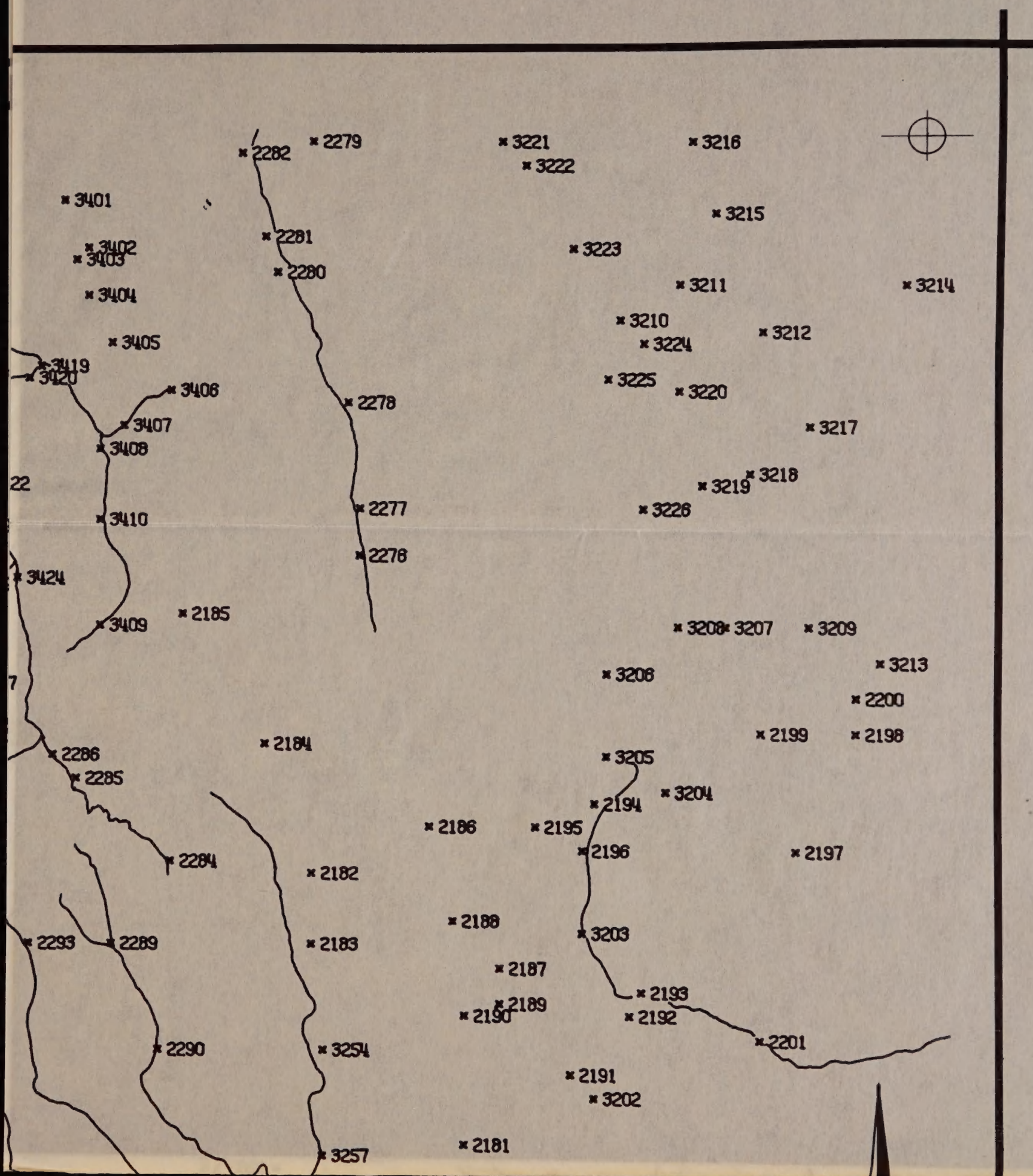


LOCATION MAP OF GEOCHEMICAL SAMPLES WITH SAMPLE NUMBERS

Plate 2

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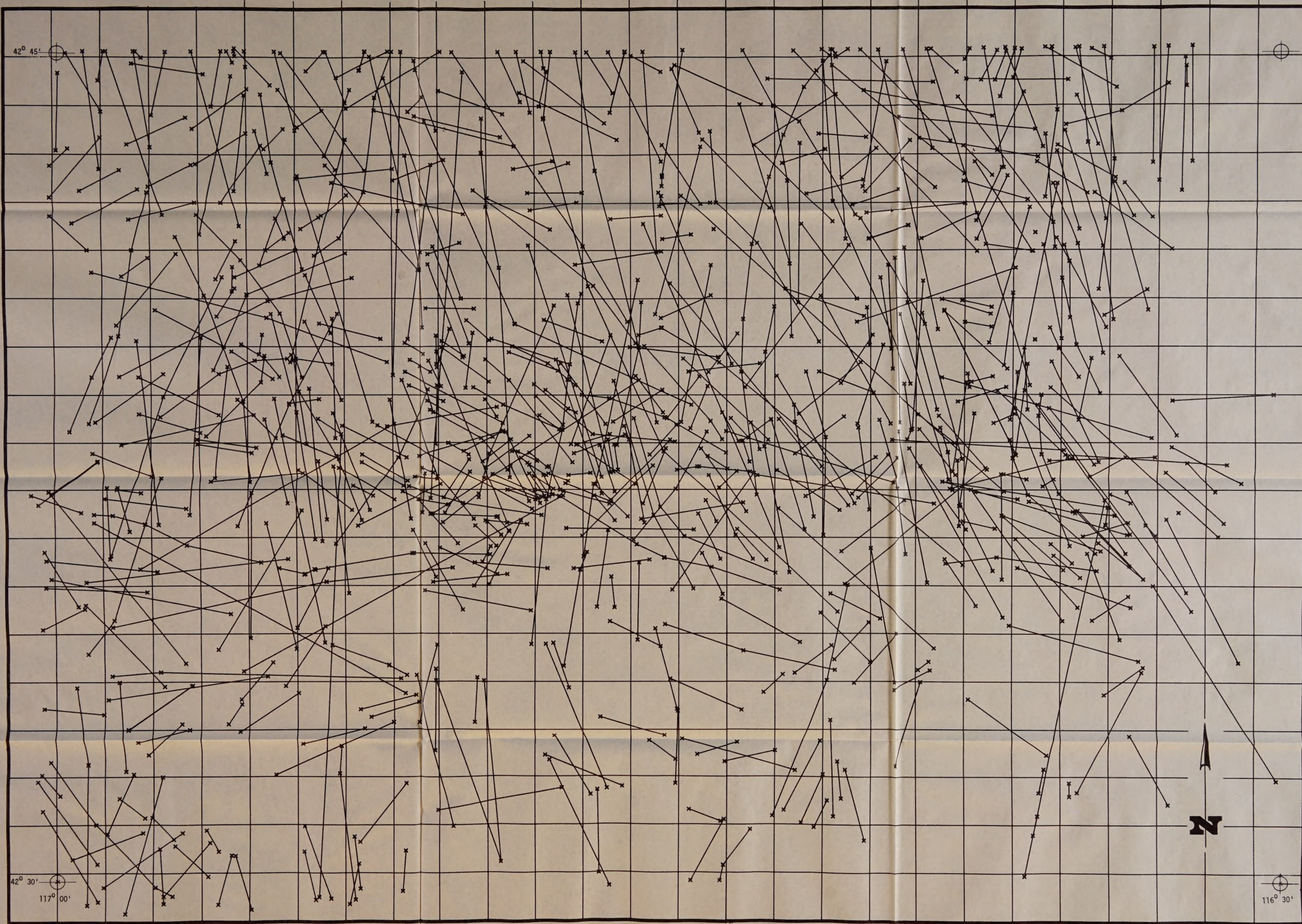






LOCATION MAP OF GEOCHEMICAL SAMPLES WITH

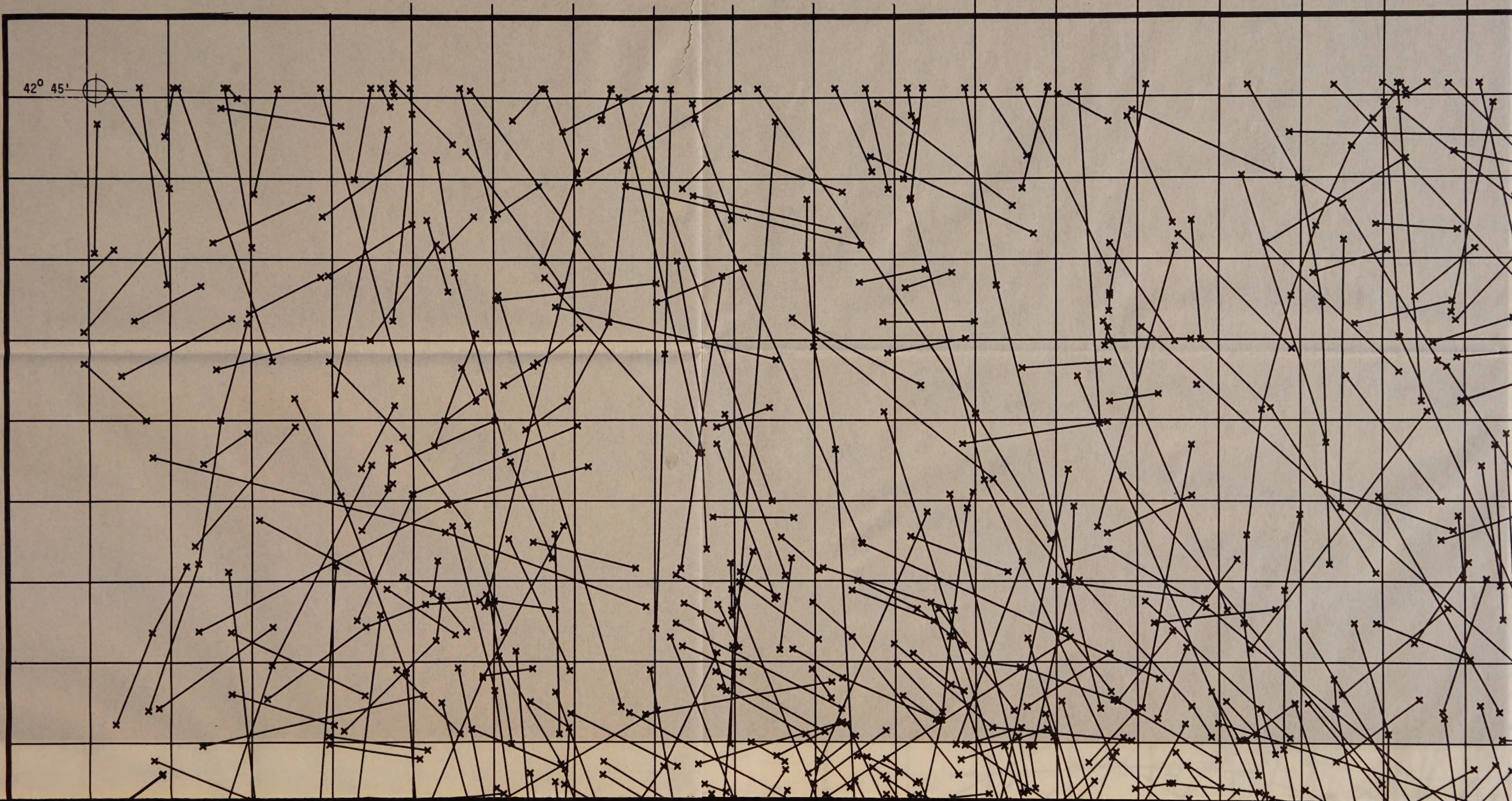
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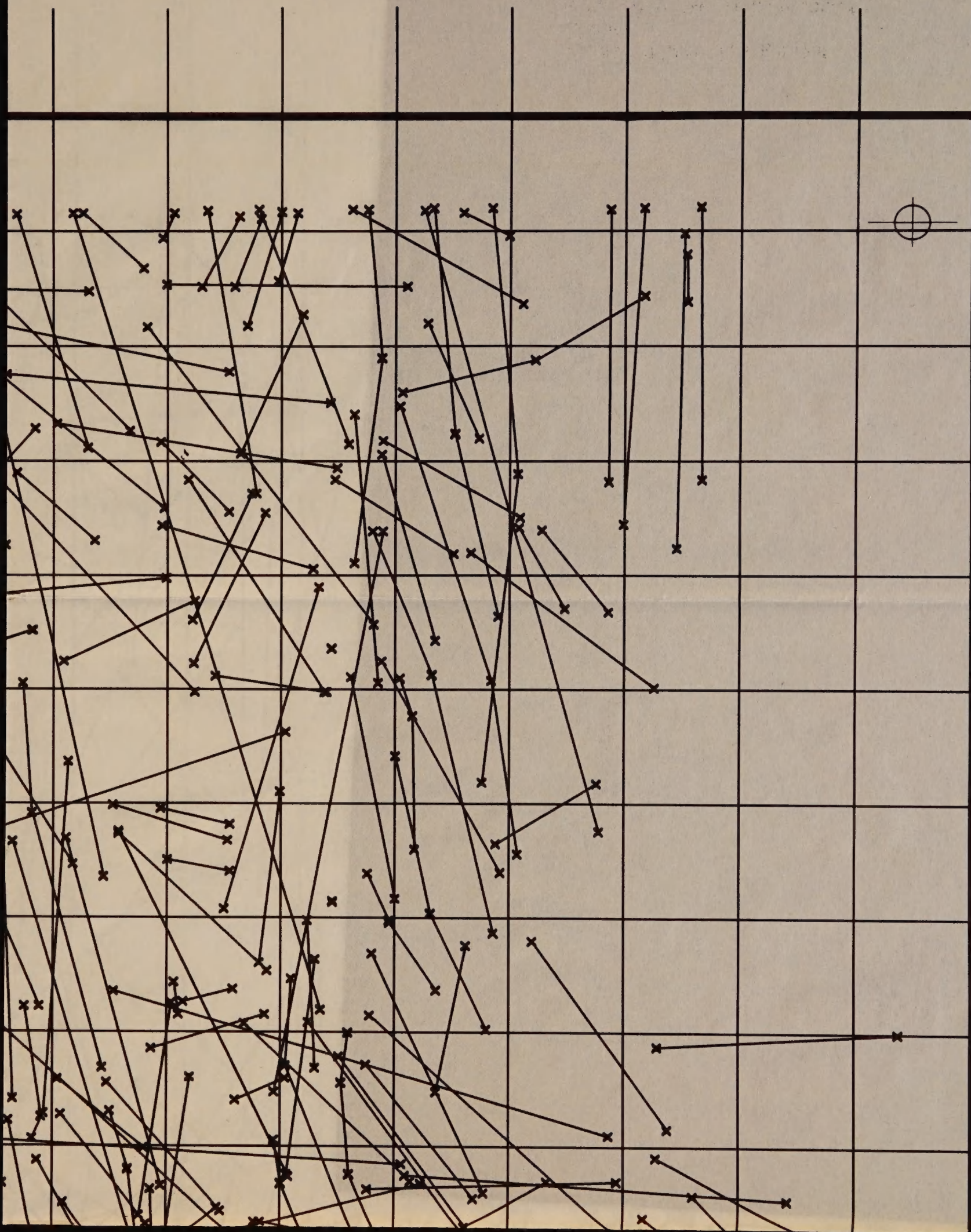


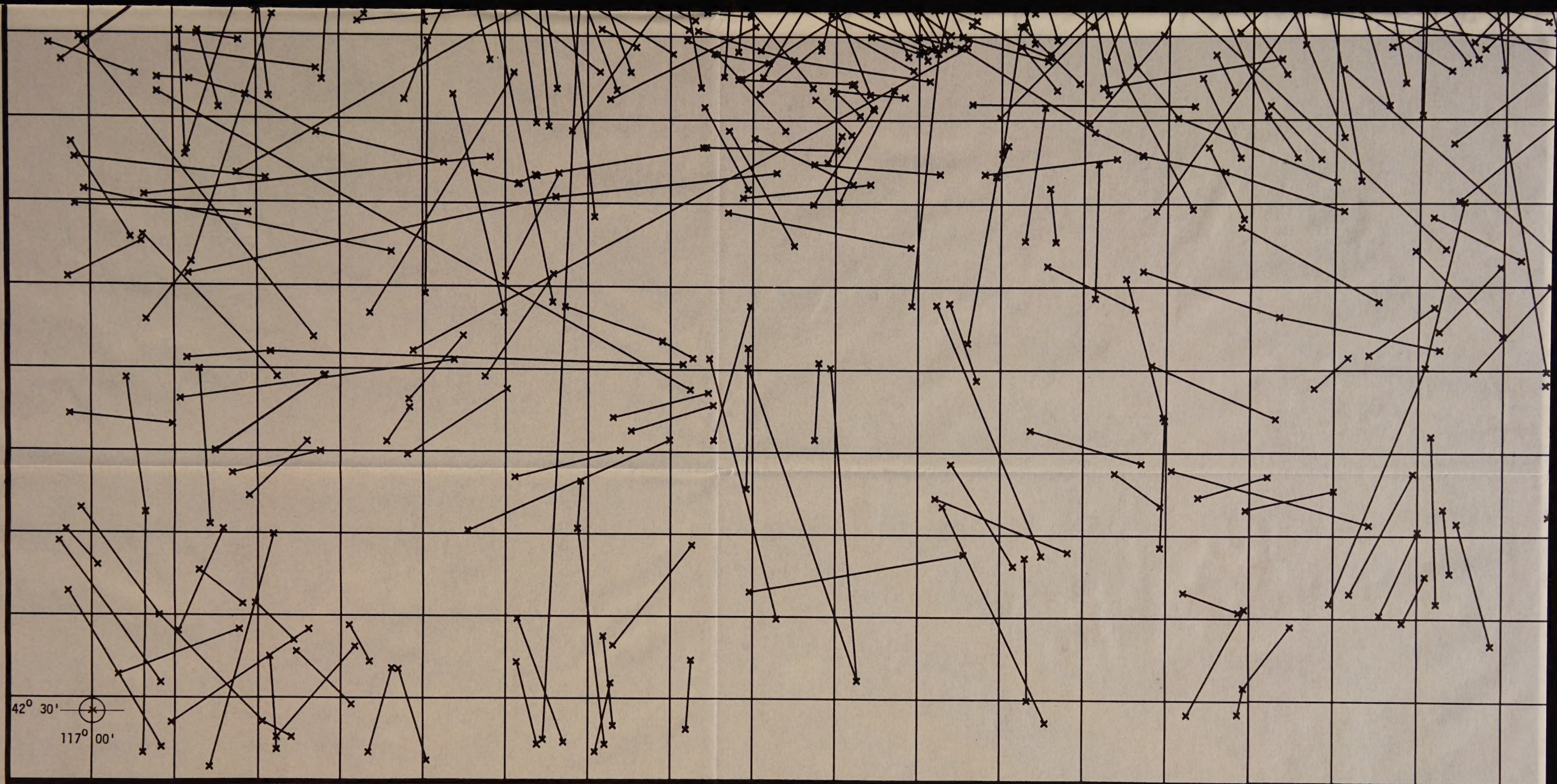
LOCATION MAP OF LINEARS IN THE SOUTH MOUNTAIN - JUNIPER MOUNTAIN REGION
(from U-2 imagery)

PLATE 3

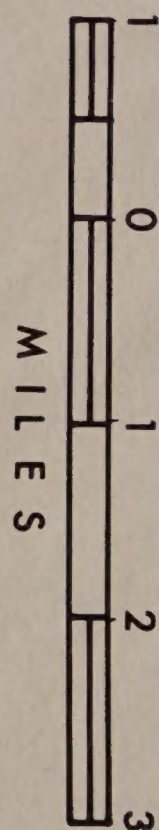
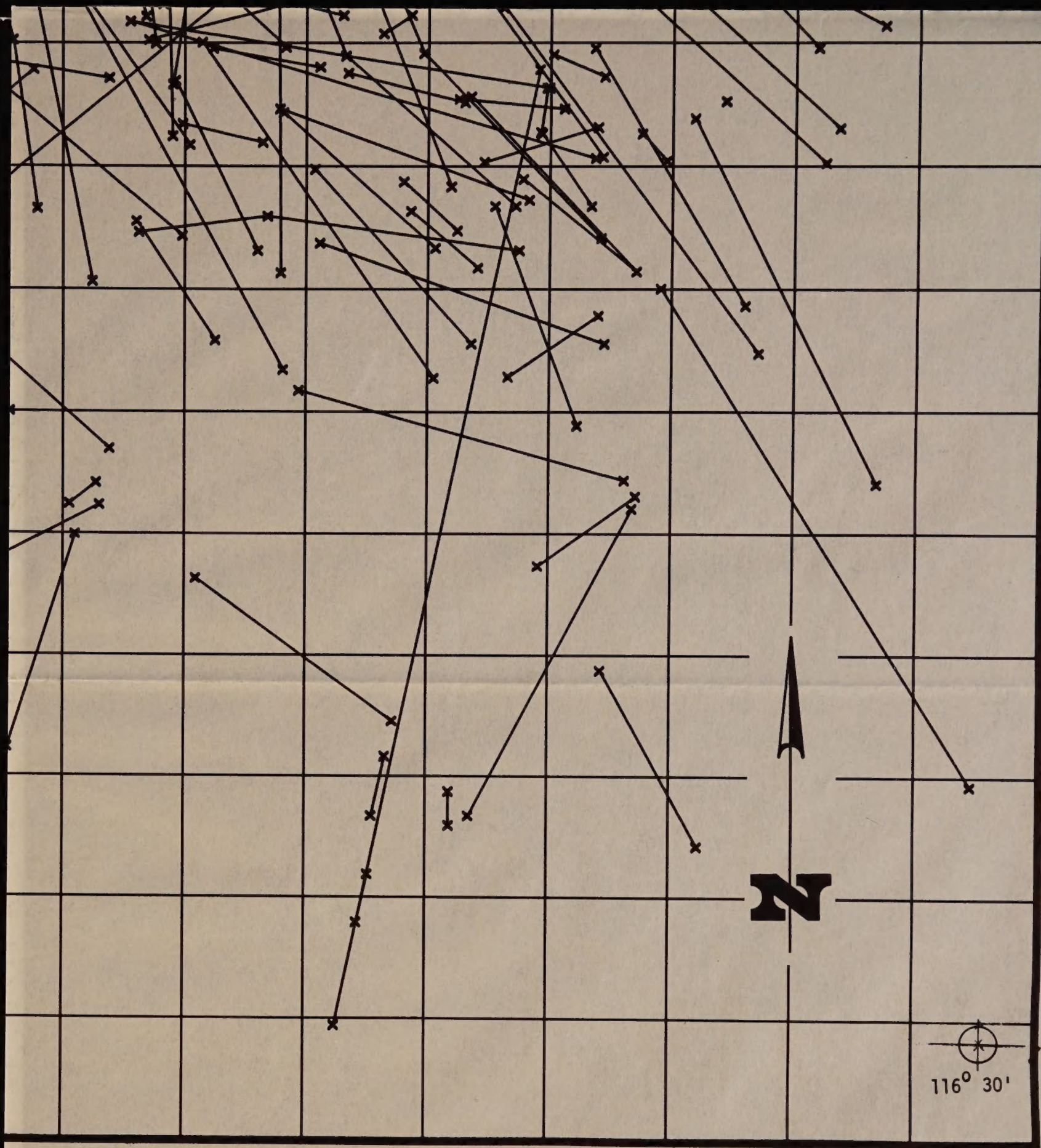
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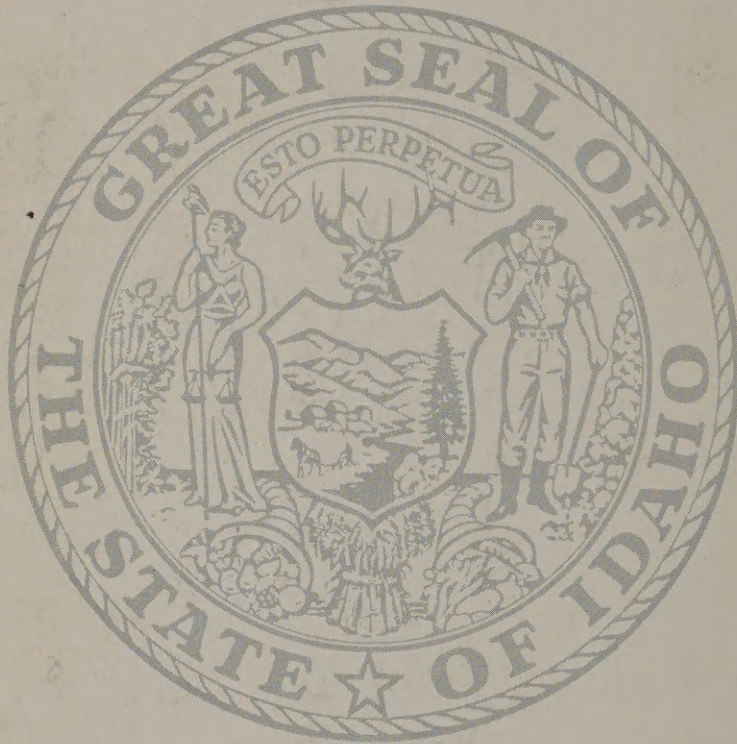


LOCATION MAP OF LINEARS IN THE SOUTH MOUNTAIN — J
(from U-2 imagery)



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